# Chemical Engineering

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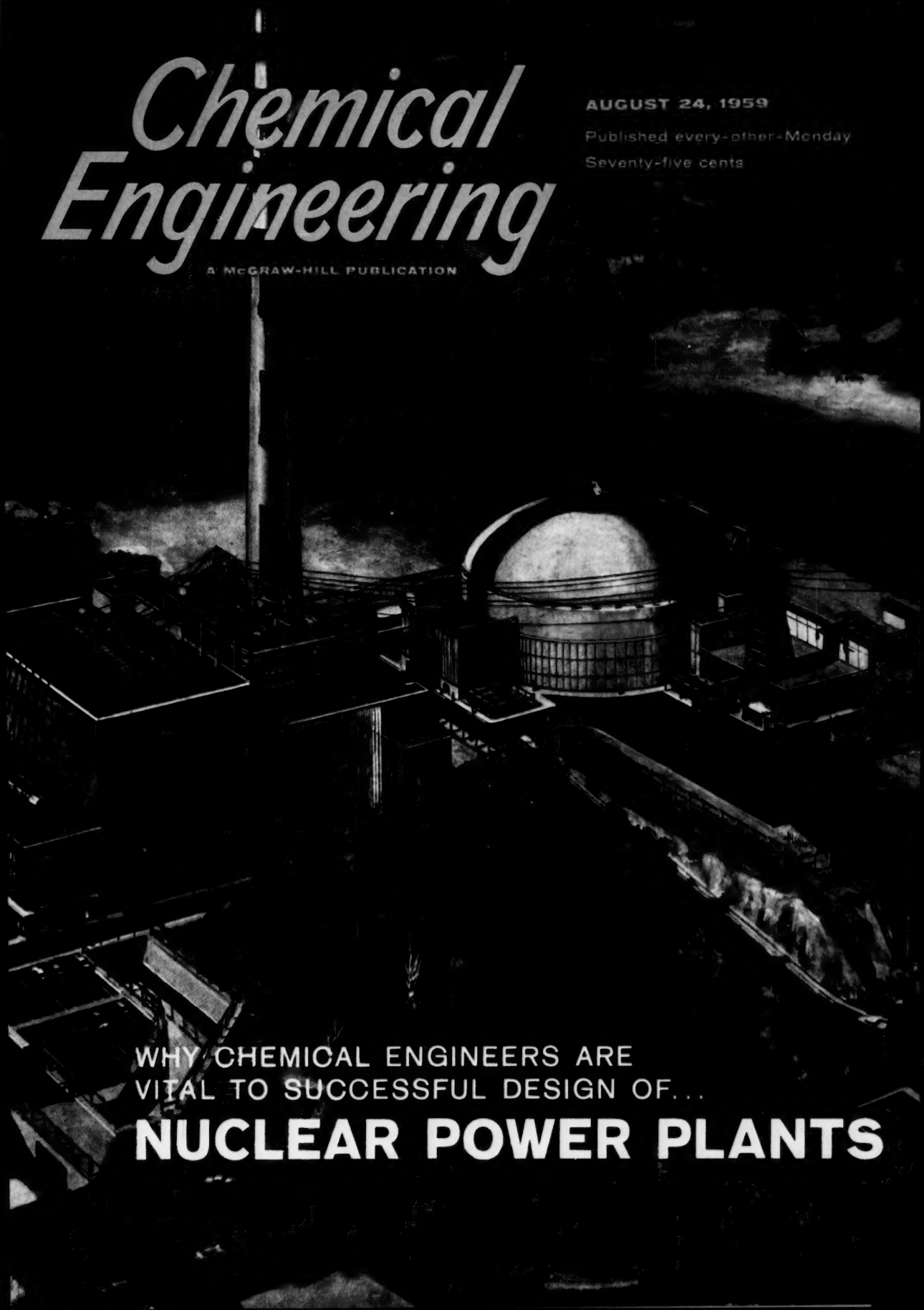
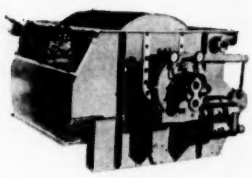


WHY CHEMICAL ENGINEERS ARE VITAL TO SUCCESSFUL DESIGN OF...

## NUCLEAR POWER PLANTS

# EIMCO®

## Continuous Vacuum and Pressure FILTERS



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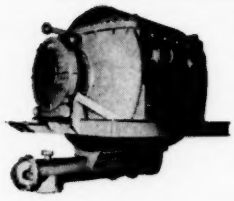

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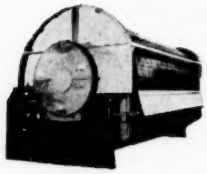
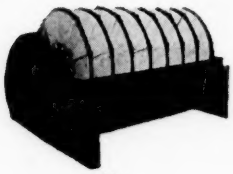


Drum



Disc

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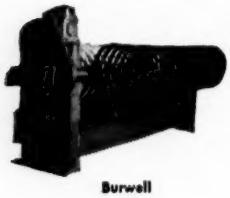
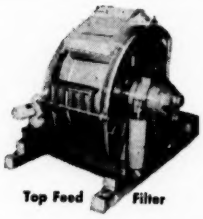
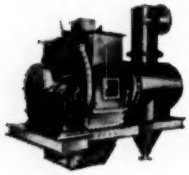


Burwell

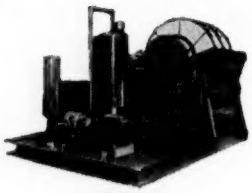


Top Feed Filter

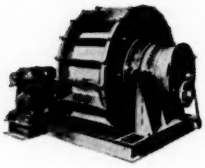
Tilting Pan



Top Feed Dryer



Pilot Plant



Top Feed Dewaterer

Lab. Filter

## Why So Many Filters?

As chemical processing technology has become more complex, so have the requirements of filtration. It is not surprising that many processing engineers are bewildered by the many separate types of vacuum and pressure filters available.

New products, new methods, new high demands for increased production and lower costs have created a need for modern equipment capable of higher recoveries . . . able to filter finer particles . . . designed for automatic or semi-automatic operation.

That's why it's such a big advantage to be able to choose a filter from the wide Eimco line. Full-range type and size availability assures you of maximum suitability of equipment. Highest filtration efficiency can be obtained in no other way.

The Eimco representative in your area can help you specify the filter most suitable for your job, and can make available Eimco's complete scientific facilities for pre-testing your materials. Ask him, or write Eimco, for new Filter Bulletin F - 2049.

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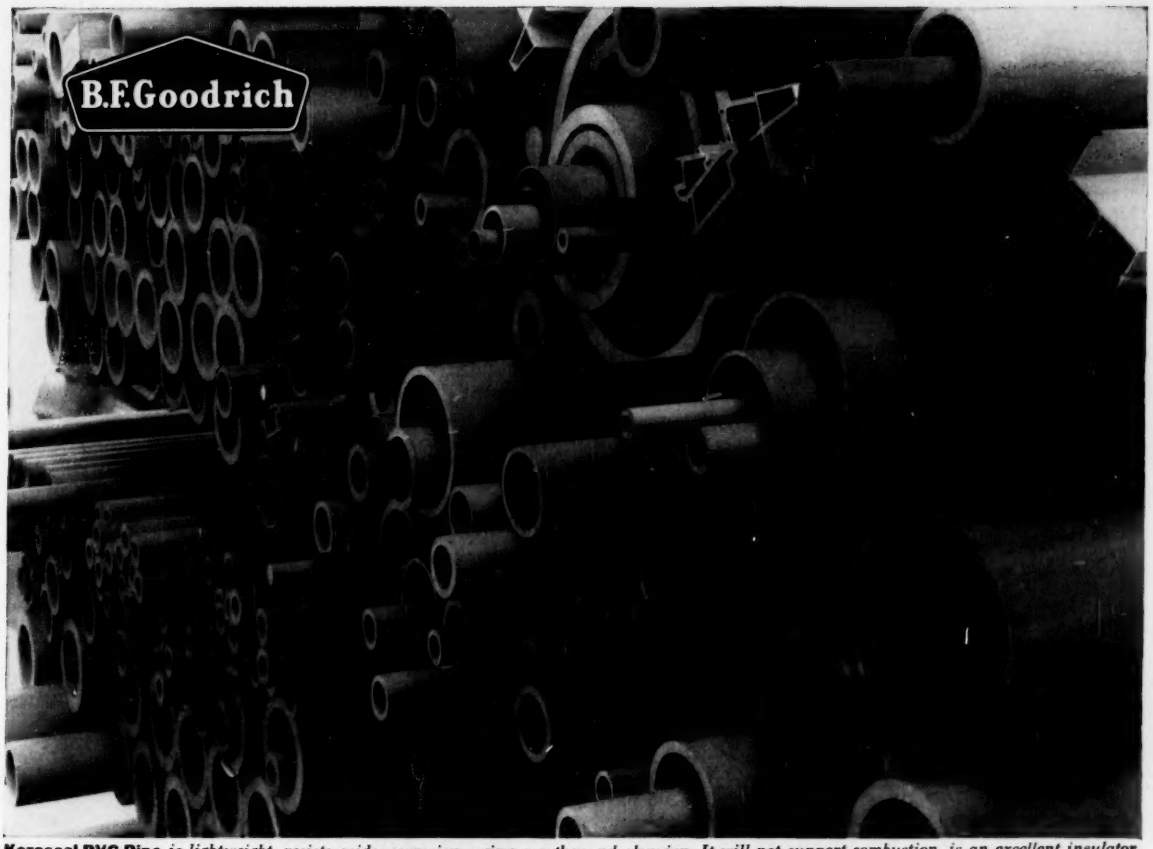
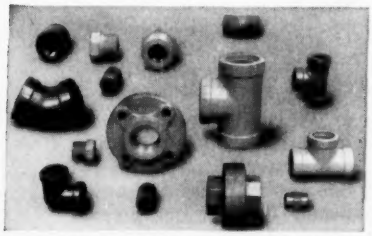


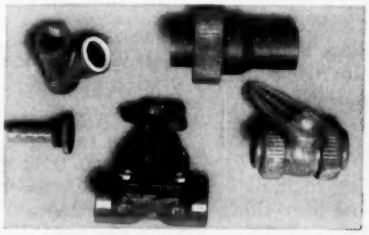

**Koroseal PVC Pipe** *is lightweight, resists acids, corrosion, aging, weather and abrasion. It will not support combustion, is an excellent insulator. Fast, easy installation and long life result in substantial cost reductions.*

# Specify Koroseal PVC pipe and fittings for long life at low cost

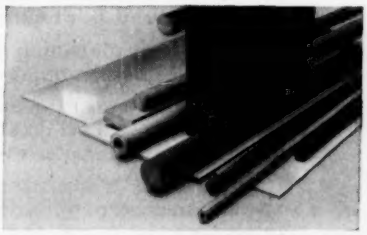
The more severe the service conditions, the more apparent are the superior properties and quality of rigid Koroseal PVC pipe, fittings, valves and sheet. Koroseal PVC is delivering long, trouble-free service in a multitude of industrial applications where corrosion, chemicals, high pressures and physical abuse ruined other types of pipe in a hurry. And savings are substantial—on original cost, installation costs, reduced maintenance and longer life. Investigate the many advantages of Koroseal PVC pipe now. For details, etc., write Dept. CE-8. *B. F. Goodrich Industrial Products Company, Marietta, Ohio.*



**Koroseal PVC Fittings** *can be joined to Koroseal pipe by solvent-cementing, heat welding, flanging or threading. Recessed threads protect against damage, eliminate cross threading. There's a size and type for every need.*



**Koroseal Valves**—*excellent for handling fluids, gases and corrosive materials. Complete selection of diaphragm, ball, and check valves for all types of service. Strainers and other piping components also available.*

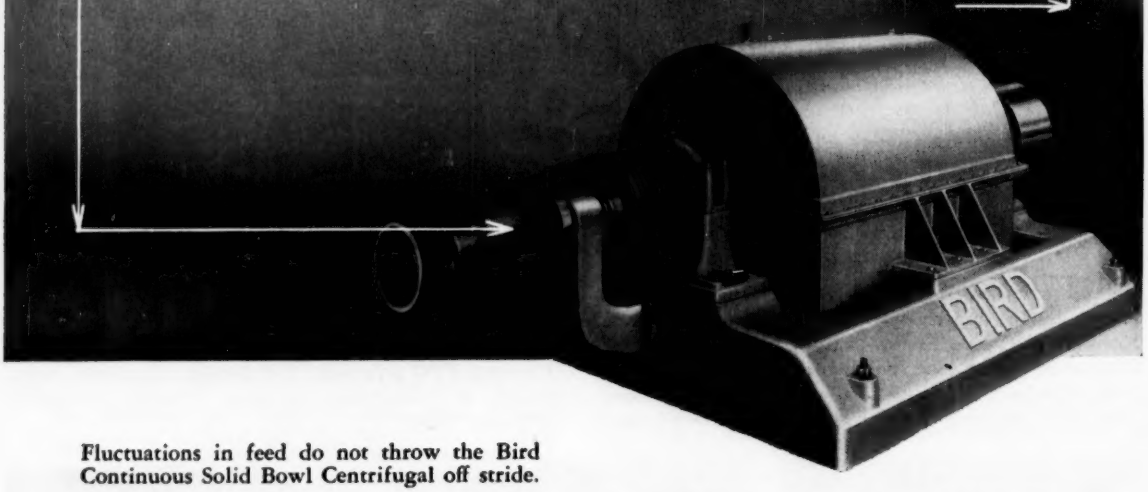


**Sheet, Tubing, Rods**—*Koroseal PVC also is available in other forms . . . sheet and fabrication aids for duct work . . . bar stock for machined parts . . . tubing for special uses.*

**B.F.Goodrich** ***Koroseal rigid PVC products***

# FEED YOUR SLURRY TO THIS BIRD . . .

- *in varying amounts*
- *at thick or thin consistencies*
- *at almost any temperature*
- *with the solids coarse or fine, or a mixture of the two*




Fluctuations in feed do not throw the Bird Continuous Solid Bowl Centrifugal off stride.

It handles feeds containing no more than 2 or 3% solids, or feeds carrying 60 to 70% solids.

It works with feeds of minus 100°F and plus 300°F. The Solid Bowl does not "blind" when hot saturated liquids "salt out".

It deliquors solids as coarse as half inch, or as fine as a fraction of a micron, and everything in between.

It is readily made fume or vapor tight. Operation may be pressurized when required.

What this means to you is that you do not have to fit the job to the filter. *The Bird fits the job.* And the Bird Research and Development Center has the test facilities to prove performance in advance of your equipment investment.

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* FREE—for your files—Check Reader Service postcard (p. 190) for an extra file copy of this guide to a better way to prepare flowsheets.

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# COOPER ALLOY VALVE BRIEFS

## THE VALVE AND FITTINGS ANSWER CORNER

Send in your questions on stainless valves and fittings to Carl Tylka, Cooper Alloy Technical Service Director.

**Q.** *Is it possible to obtain a valve which, like a globe valve, possesses linear throttling characteristics, but which also, like a gate valve, has low fluid pressure drop across it when fully opened?*

**A.** Not throughout the entire flow range of the size valve being considered. A very close approximation, however, may be attained with a Flex-Plug type design (a unique new valve patented by Cooper Alloy), which provides linear throttling response up to 90% of full valve flow. The 10% balance of the upper flow region would exhibit a typical gate valve flow pattern.

**Q.** *How can one prevent oxidation of active ferrite ion on the fluid side of a cast stainless valve body?*

**A.** This type of corrosion is commonly found on untreated cast stainless surfaces only, and may be caused by foundry, machinery, and handling techniques. Proper pickling and passivation with thorough mechanical cleaning will generally rectify this, though in some cases actual weld repair of the contaminated surface is required. Since this is a surface condition only, machining or grinding will also help.

**Q.** *What type of valve do you recommend for manual-control services where minimum pressure drop is required?*

**A.** In the absence of more detailed knowledge of the problem, I would tentatively recommend an angle valve. The pressure-drop characteristics of this type valve are less than 50% those of conventional globe valves.

**Q.** *Is it advisable to specify installed valve position on an order?*

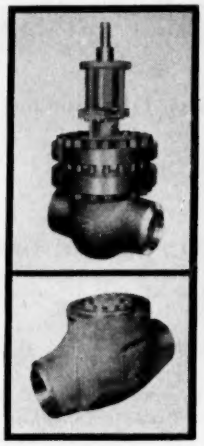
**A.** Definitely. By inclusion of this information, definite design considerations can be incorporated, especially in cases where backseat leakages are critical and mechanical valve operation is involved.

**Q.** *Is it advisable to install valves smaller than the accompanying pipe sizes?*

**A.** Where flow and pressure considerations so permit, it is not only advisable but also economically beneficial.

**Q.** *Why aren't valve bodies with butt weld and connections made shorter?*

**A.** To prevent distortion of the seating surfaces during installation. The longer length is required for heat dissipation during welding.



Above left, Cooper Alloy 16" cast stainless gate valve ready to receive gear motor drive; lower left, Cooper Alloy 12" cast check valve. Both are rated for 2500 psi service at 670°F. Official AEC photo above shows them in place in nuclear process line.

## Cooper Alloy cast stainless valves spurt ahead of competition to win acceptance in AEC's Spert III reactor program

**Cast yield strengths of 23,000 psi, plus cost savings of 40%, do the trick!**

This is a Cooper Alloy success story in another "first": casting of stainless valves and fittings to strength levels actually surpassing those previously possible only in forgings—and doing it all at a 40% saving to the customer!

The story starts, naturally, with the AEC's valve and fitting specifications, which are rugged indeed. They have to be certified to function continually at elevated pressures and temperatures (2500 psi, 670° F.), under which conditions leakage, corrosion, and other operational problems are magnified enormously over those encountered in normal process work.

Prior to turning to Cooper Alloy, the contractor for the AEC cancelled a large valve order from another supplier, because the latter could not meet the exacting physical specs without changing the material specs. Cooper Alloy was given the order on the basis of producing to meet AE and AEC specs. Cooper Alloy valves and fittings are currently in operation in the AEC's Spert III installation at Arco, Idaho. Included are nuclear fittings, and motor and manual operated gate, globe, and check valves in various sizes.

How does Cooper Alloy do it? Through the use of the most advanced foundry methods, meticulous attention to conditions, and an exact balance of chemical composition to develop the maximum strength characteristics inherent in the complex structure of stainless alloys. All products, naturally, are elaborately tested and guaranteed before delivery.

As if the AEC's specs were not stringent enough, there is now a bonus to the story: during production, Cooper Alloy technicians worked out ways of producing cast strengths higher than those required, and proceeded to produce all fittings and valves to these higher, self-imposed standards—at cost savings of 40% over forged valves and fittings!

Unusual, yes, but not to Cooper Alloy. It's typical of the quality bonus you get when you buy from Cooper Alloy. For further information, write to Cooper Alloy Corporation, Hillside, N. J.

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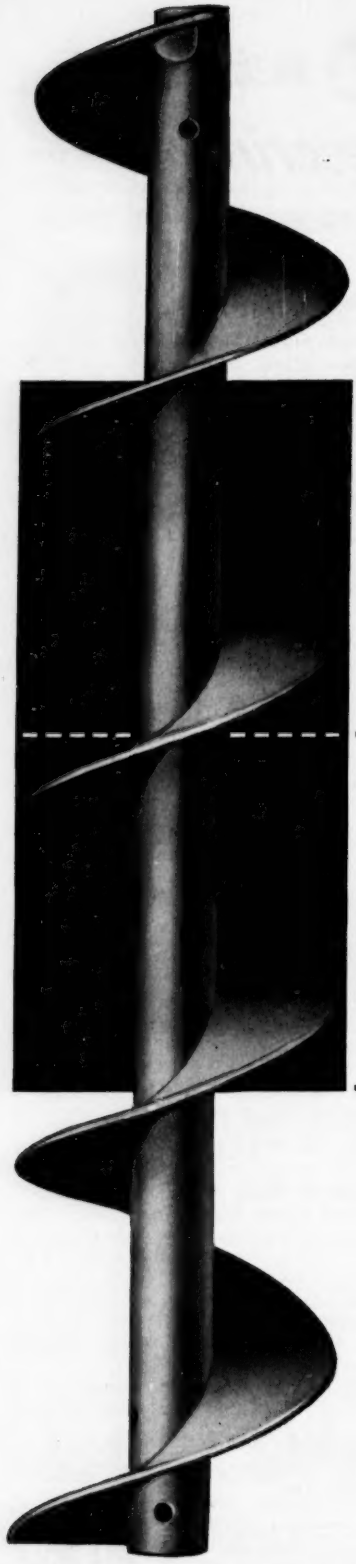
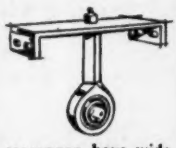
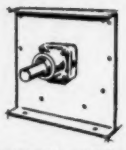
*your only source for many*



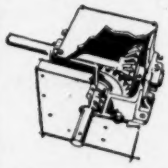
**QUIK-LINK CONVEYOR SCREW.** For ease in removal of conveyor section without disturbing other components. Can be furnished on Helicoid and Sectional flight conveyors.



**HANGERS** have wide top bar with slotted bolt holes for easy assembly and alignment. Available with self-aligning ball bearing or with sleeve bearing in babbitt, hard iron, bronze or oil impregnated wood.



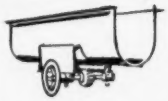
**TROUGH ENDS** of heavy steel plate are flanged at top and bottom. Furnished with babbitted, bronze or single or double ball bearing flange block, with or without trough end seal. Blocks are interchangeable.



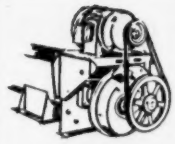
**COUNTERSHAFT ENDS** with ball and roller bearings or babbitted bearings, for right angle drive applications— common drive for two conveyors at right angles.

**TROUGHS** are accurately formed and jig-assembled. Steel angles securely welded to trough plate form top flanges. Can be made of stainless steel or other special metals to suit specific requirements.

**SEMI-FLANGED, SPRING CLAMP COVERS** are more rigid, easier to handle and form a tighter seal than plain type cover. Spring clamps are attached to cover—simplifies installation.



**DISCHARGE SPOUTS AND GATES** can be located anywhere along length of conveyor trough. Gates can be flat or curved —hand or rack-and-pinion operated.



**DRIVES.** Link-Belt shaft-mounted speed reducers are simple, compact — can be mounted directly on trough end plate. Motogears and Gearmotors with roller chain drives can also be furnished.

With seventeen basic screw designs, and a full line of components, Link-Belt can furnish anything you need from a single component to a complete line of screw conveyor.

As the foremost producer in this field, Link-Belt offers a range of new product improvements for profitable operation. Quik-Link conveyor screws, hangers, trough ends with ball or sleeve bearings, jig-welded troughs with new semi-flanged spring clamp covers—these and many more are cutting power demands and maintenance costs.

If you have bulk materials to be handled, it will pay you to look into the Link-Belt screw conveyor line. All components are available from stock. Call or write your nearest Link-Belt office or authorized stock-carrying distributor for Book 2989.

**LINK-BELT**

**SCREW CONVEYOR**

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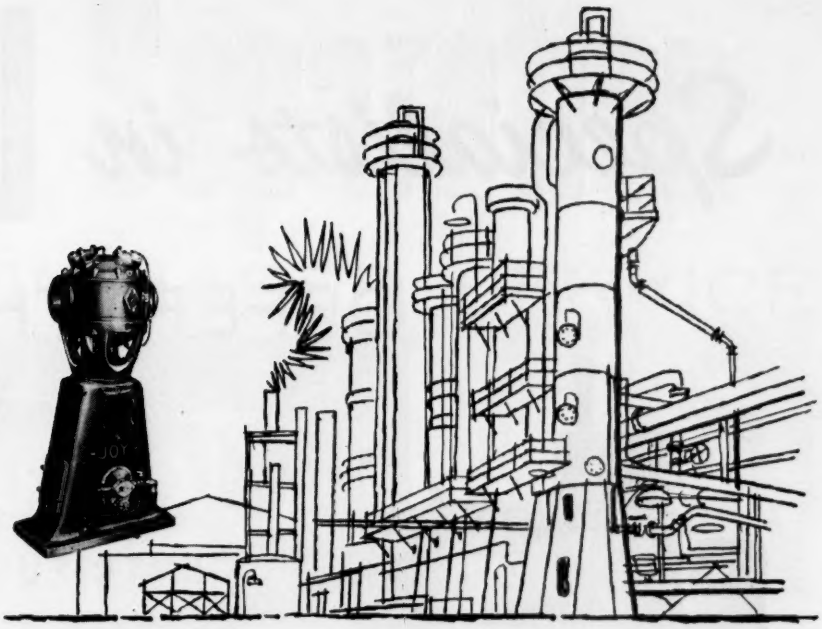

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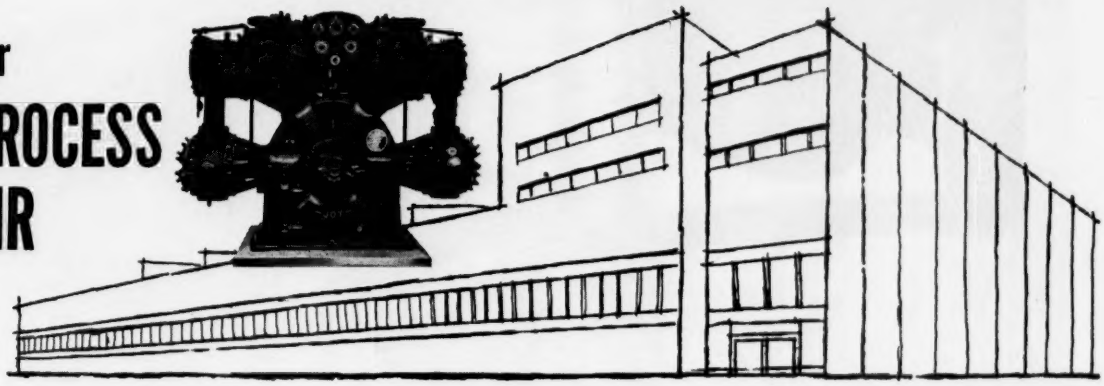
# PROCESS AIR



# JOY OIL-FREE COMPRESSORS UP TO 15,000 HP

Air actuated instruments are reliable only if the compressed air is absolutely oil-free. That's why so many companies have chosen Joy WGO-9 compressors to power their pneumatic instruments. With capacities from 95 to 900 cfm, the WGO-9 is the dependable, economical way to produce clean, oil-free air for instruments.

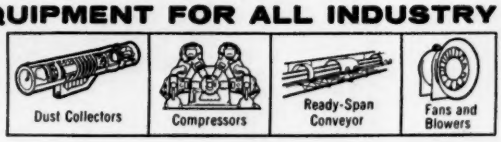
And if oil-free air is required in larger amounts for processes throughout the plant, Joy has a complete line of larger units. A special carbon-graphite piston ring design, patented by Joy, eliminates the need for lubrication in the cylinders. Even in the larger sizes, with capacities up to 4000 cfm, these rings give excellent service with operating life of 8000 hours and more.

Joy also makes a line of centrifugal and axial compressors for oil-free service up to 15,000 horsepower. If you have a need for clean, dry oil-free air, talk to a Joy engineer.

DATA
For complete information on Joy oil-free compressors, write for bulletin 330-11.

17640-330

**AIR MOVING EQUIPMENT FOR ALL INDUSTRY**



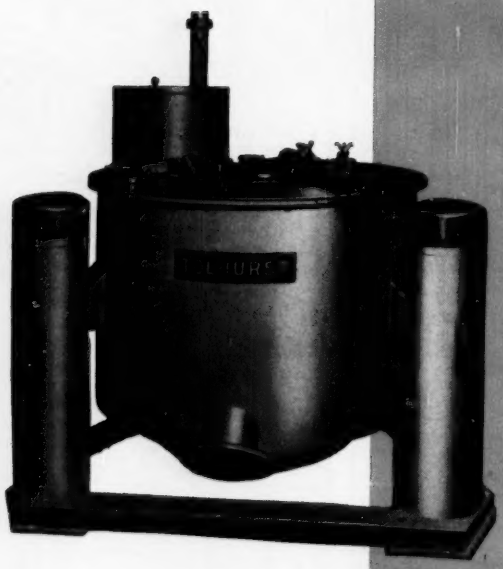

**JOY**

**Joy Manufacturing Company**
**Oliver Building, Pittsburgh 22, Pa.**

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

# *Specialists in* Liquid-

## OFFER THIS COM



## Tolhurst®

### CENTRIFUGALS

- BATCH-O-MATIC®
- BATCH-MASTER®
- SUSPENDED
- CENTER-SLUNG®
- MAXI-FLEX®
- CONTINUOUS

## FE INC® CONTINUOUS FILTERS

(pressure type)

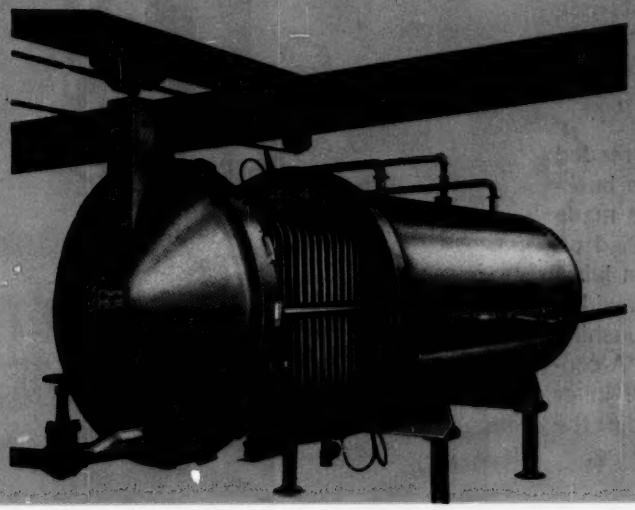
*Custom Engineered*

- VACUUM OR PRESSURE ROTARY DRUM
- HORIZONTAL TABLE

# Solids Separation

## PLETE UNBIASED SERVICE

## Niagara® FILTERS



- **VERTICAL LEAF MODELS** in both horizontal and vertical tank designs.
- **BATCH-MISER®** horizontal plate models for polish filtration and batch operations.
- **ALL ASME** Code Construction.

## FEON®

Available by the roll or tailored to fit all types of fluid/solid separation process equipment.

- **NATURAL AND MAN-MADE FILTER MEDIA**

FEON Woven Textile Fiber Fabrics
FEON Non-woven Textile Fiber Fabrics
FEON Filter Papers by Rochester Paper Co.

• Laboratory Tested • Production Proven

*Write for literature. Please specify:* **TOLHURST . . . FE$^{INC}$ . . . NIAGARA . . . FEON**

**DIVISIONS OF**

**American Machine and Metals, Inc.**

**EAST MOLINE, ILLINOIS**

*COMPLETE LABORATORY TESTING FACILITIES AT YOUR SERVICE*

# LOOK FIRST TO **POWELL**

## Features of Construction:

Powell Corrosion Resistant Valves are made in stainless steel, Monel, nickel, Hastelloy alloys, aluminum and other special corrosion resisting metals.

Solid and double wedge discs of gate valves are interchangeable. They are precision machined and fitted and are accurately guided throughout their entire travel. This prevents drag of the disc over the seat faces, eliminating wear of seating surfaces and stops undue vibrational noises.

O.S.&Y. Valves—Stems are threaded and guided through a bronze bushing in upper yoke. (Bushings made of other alloys can be supplied on special order.) A compression lubricant fitting in upper yoke is provided to lubricate the stem and bushing threads and to reduce wear. A convenient shelf is cast on the inner sides of yoke arms for suspending the gland when renewing the packing.

All valves are regularly packed with Teflon Packing. Globe and "Y" valves are available with metal or Teflon discs.

Globe, Angle, Gate and "Y" valve stems are back seated for repacking under pressure when fully open.

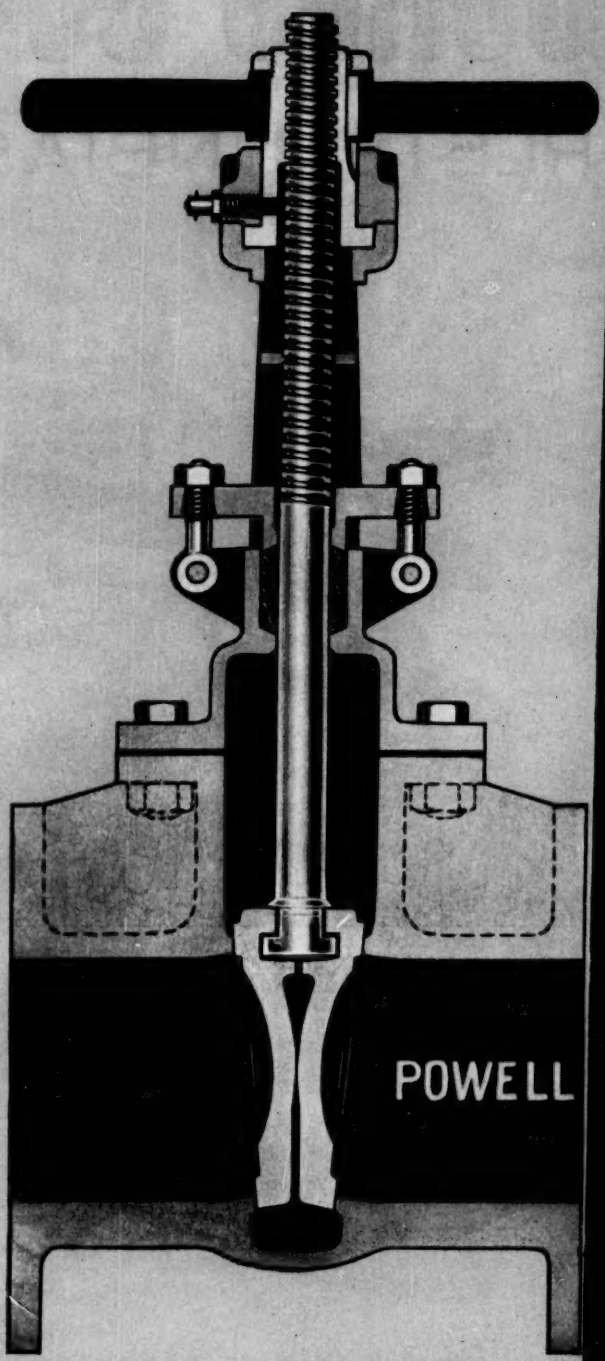



**Fig. 2453 DG (Sectional)—Large Stainless Steel O.S.&Y. Gate Valve. Available with interchangeable solid or split wedges. Wedges are fully guided throughout their travel.**

**POWELL...world's largest family of valves**

# FOR CORROSION RESISTANT VALVES

**Over a quarter century ago,** Powell introduced the Corrosion Resistant Valve. Now, after years of pains-taking experiments and exhaustive research, Powell offers Valves to handle practically every corrosive fluid—valves of every design, and in the largest possible selection of metals and alloys.

For all your flow control requirements—water, oil, gas, air, steam, as well as corrosive fluids—Powell has the right valve in the right size and the right metal. Consult your local Powell distributor or write directly to us.

Fig. 2633—Large, Stainless Steel Swing Check Valve for 150 W.P. Sizes, 2" to 12".

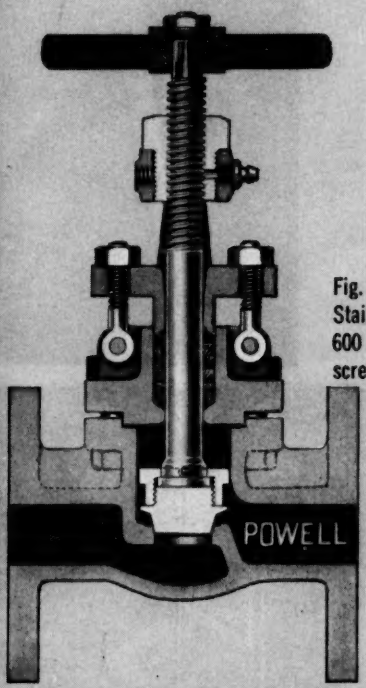
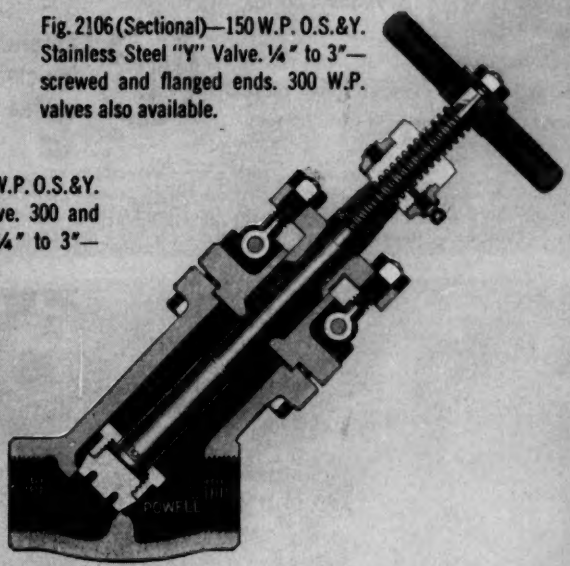



Fig. 2475 (Sectional)—150 W.P. O.S.&Y. Stainless Steel Globe Valve. 300 and 600 W.P. also available. ¼" to 3"—screwed and flanged ends.

Fig. 2106 (Sectional)—150 W.P. O.S.&Y. Stainless Steel "Y" Valve. ¼" to 3"—screwed and flanged ends. 300 W.P. valves also available.



**THE WM. POWELL COMPANY** • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

## Sure Source of top-quality plate work . . .

# American Bridge at Orange, Texas.

If your business requires equipment made from steel plate—heavy-wall pressure vessels, tanks, stacks, bins, pipe, etc.—American Bridge invites your attention to its recently modernized plate fabricating facilities at Orange, Texas.

The plant itself, one of the largest in the country, is a huge two-aisle building, 177′ wide and 750′ long, with crane runways extending 270′ and 200′ at either end. Equipment includes seven cranes capable of lifting, in combined use, over 100 tons.

Fabricating facilities include large car bottom-heating and stress-relieving furnaces, heavy-plate bending rolls, a variety of presses and press brakes, the latest in welding and X-raying equipment, plate shears, edge planers, boring mills and drills.

These facilities enable American Bridge to handle practically any plate job regardless of size. And great capacity permits the handling of several large jobs simultaneously.

**Efficient and economical construction service, too!**

American Bridge has the most complete range of construction equipment in the industry, plus skilled personnel backed by over fifty years of experience. *Anything we fabricate, we can erect.*

And, because of the strategic location of our Orange plant on water, rail and truck routes, you can count on fast delivery and low shipping costs.

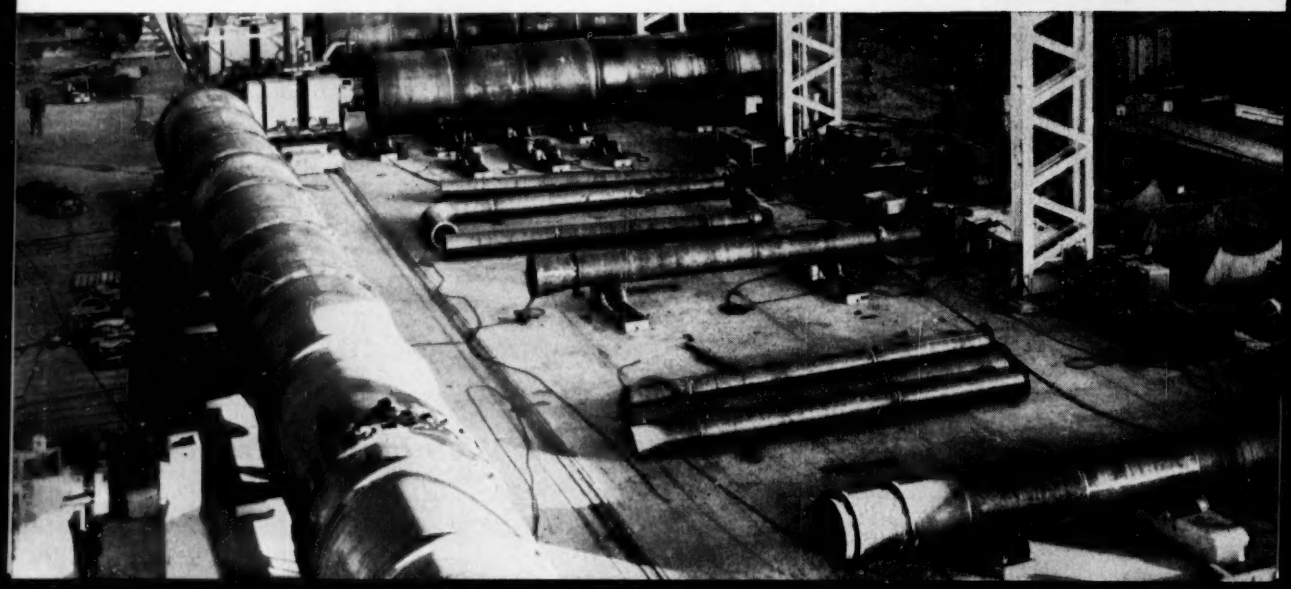
For top-quality plate work, contact any of the offices listed below. Or write for our booklet which describes the facilities and services available from our Orange plant.

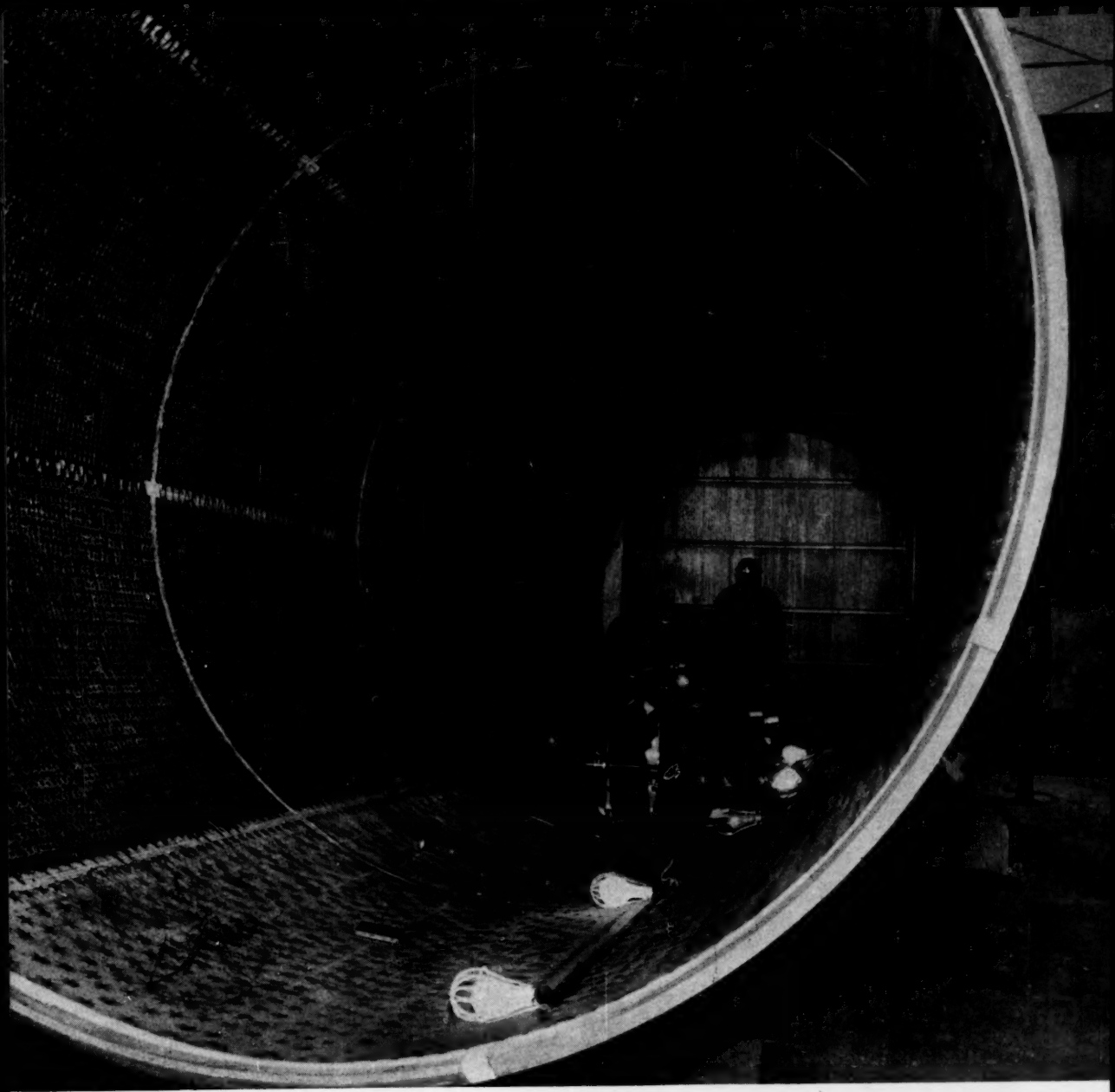
*USS is a registered trademark*

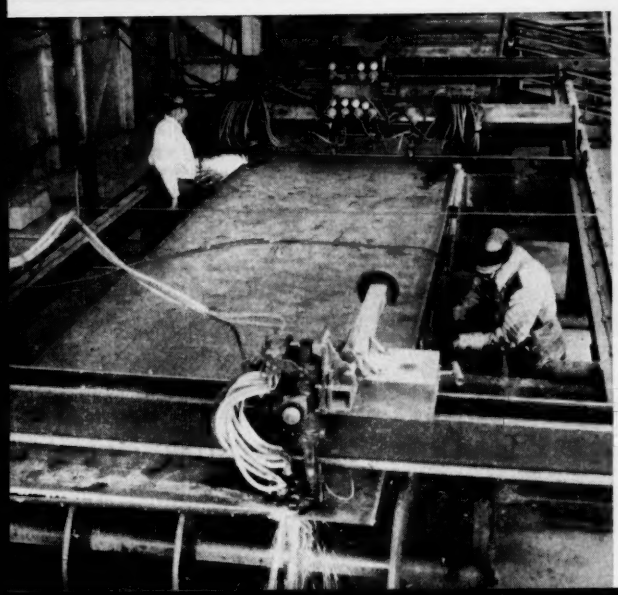
**American Bridge Division of United States Steel**

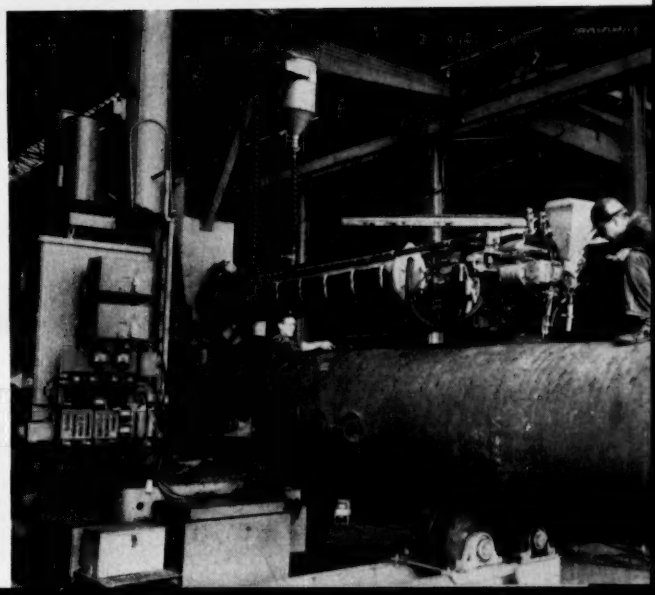
Genera Offices: 525 William Penn Place, Pittsburgh, Pa.

Contracting Offices: Ambridge • Atlanta • Baltimore • Birmingham • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver Detroit • Elmira • Gary • Harrisburg, Pa. • Houston • Los Angeles • Memphis • Minneapolis • New York • Orange, Texas • Philadelphia Pittsburgh • Portland, Ore. • Roanoke • St. Louis • San Francisco • Trenton • United States Steel Export Company, New York





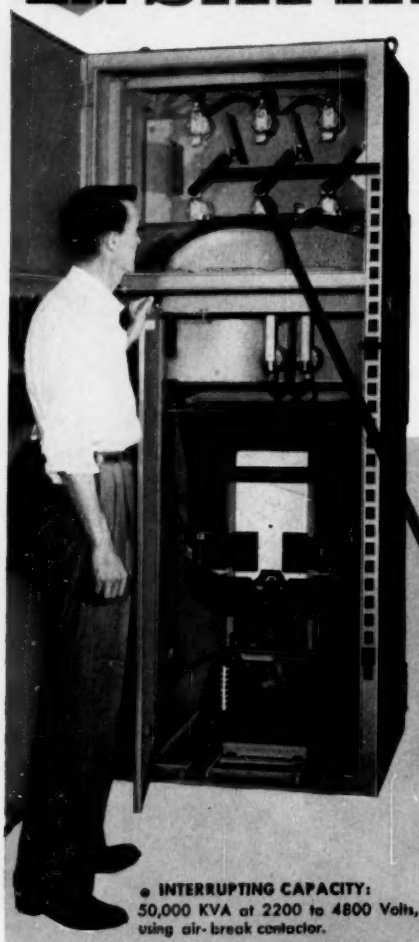




*For those who think twice about*

# TWO E-M MOTOR CONTROL LINES

## E-M SAFAIR Magnetic Control (NEMA CLASS E-1)



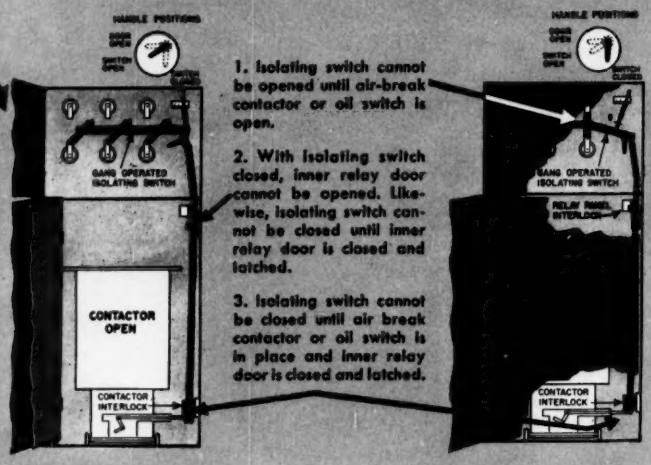
● **INTERRUPTING CAPACITY:** 50,000 KVA at 2200 to 4800 Volts, using air-break contactor.

### *Compare these features with those of your present controls*

1. **Complete Personnel Safety** with a foolproof system of mechanical interlocking between gang-operated isolating switch, oil switch or air-break contactor, and compartment doors.

2. **Complete Motor And Control Protection.** Skillfully engineered and applied components are carefully coordinated to protect both motor and control over complete design range of overload and fault conditions.

**You can't make a mistake with the E-M Mechanical Interlock!**




1. Isolating switch cannot be opened until air-break contactor or oil switch is open.

2. With isolating switch closed, inner relay door cannot be opened. Likewise, isolating switch cannot be closed until inner relay door is closed and latched.

3. Isolating switch cannot be closed until air break contactor or oil switch is in place and inner relay door is closed and latched.

**E-M SAFETY-GANG ISOLATING SWITCH** of SAFAIR Control is externally operated, internally interlocked as detailed in color and diagrams above, right.

SAFAIR features a 50,000 kva (NEMA Class E-1 maximum rating) air-break contactor suitable for repetitive motor starting and rapid switching in a complete line of squirrel-cage and wound-rotor induction motor controls and synchronous motor controls.

## PFR *for Simple, Reliable SYNCHRONOUS MOTOR CONTROL

Safair- and Safuse-controlled synchronous motors pull into step smoothly and powerfully every time. E-M-invented *Polarized Field Frequency Relay system of synchronous motor

3300-TPA-2189

## ELECTRIC MACHINERY

*Originators of the safety-gang*

*their men and motors...*

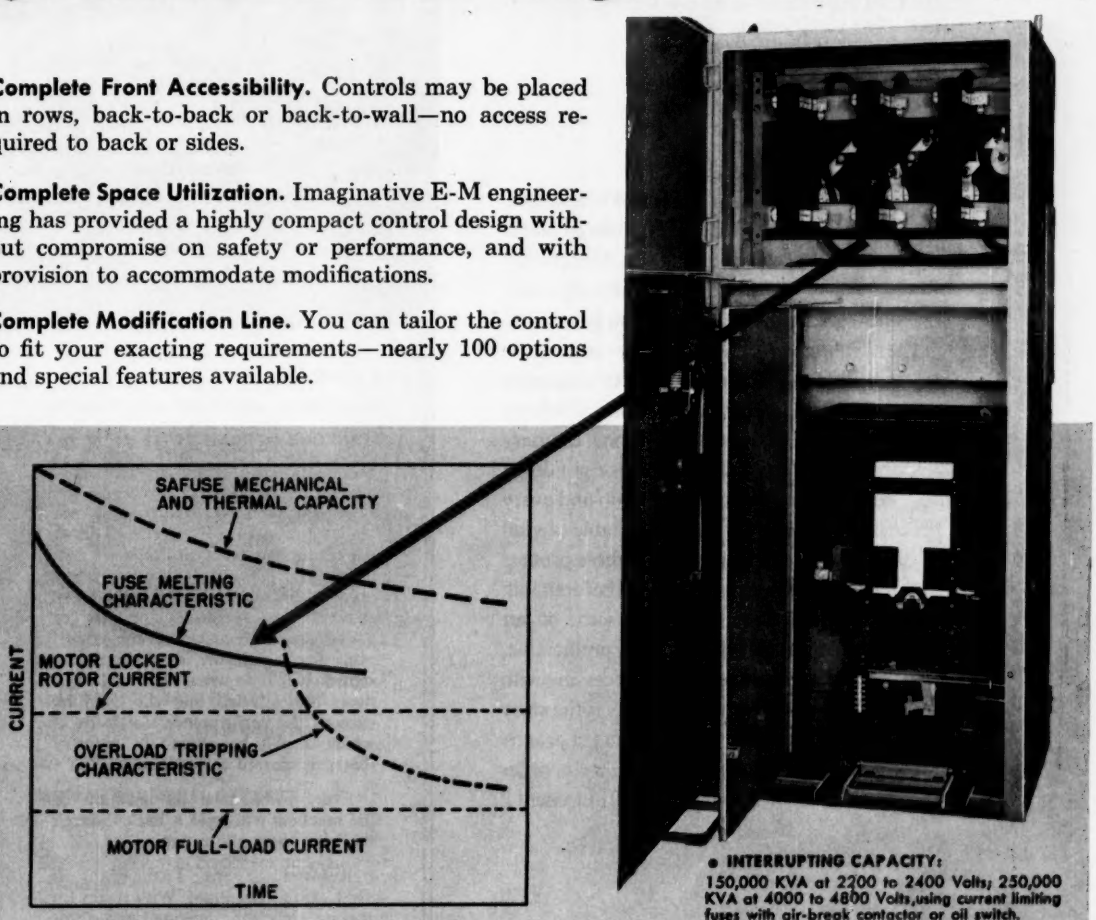
# OFFER COMPLETE PROTECTION!

## E-M SAFUSE Magnetic Control (NEMA CLASS E-2)

**3 Complete Front Accessibility.** Controls may be placed in rows, back-to-back or back-to-wall—no access required to back or sides.

**4 Complete Space Utilization.** Imaginative E-M engineering has provided a highly compact control design without compromise on safety or performance, and with provision to accommodate modifications.

**5 Complete Modification Line.** You can tailor the control to fit your exacting requirements—nearly 100 options and special features available.






• **INTERRUPTING CAPACITY:** 150,000 KVA at 2200 to 2400 Volts; 250,000 KVA at 4000 to 4800 Volts, using current limiting fuses with air-break contactor or oil switch.

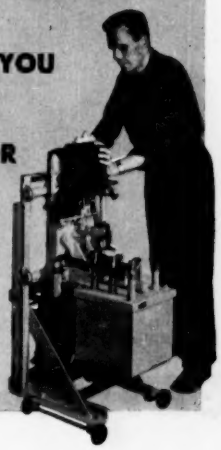
starting and synchronizing is sensitive to the electrical condition of the field winding, applying field excitation at proper rotor angle for maximum synchronizing torque with minimum current inrush... and it's coupled with E-M's modern field failure protective system.

**FAST ACTING FUSES** *plus* E-M Safety-Gang Isolating Switch in SAFUSE are the best possible combination for complete motor and control protection thru NEMA Class E-2 maximum ratings. The current limiting fuses provide short circuit protection and are carefully coordinated with overload relays as shown in diagram above.

Complete information and helpful application data are available from your E-M Field Engineer. Call him and write the factory for publications 242A and 249.

**SAFUSE GIVES YOU CHOICE OF AIR-BREAK CONTACTOR OR OIL SWITCH**

For highly repetitive duty use the roll-out air break contactor. But for less frequent starting—or in areas of severe dust, dirt, moisture, or corrosive fumes—the roll-out oil switch is recommended.



**MFG. COMPANY** MINNEAPOLIS 13, MINNESOTA

*disconnect high-voltage fused control*

**Fred Wheelwright, Manager, Industrial Sales:**
"We're taking this opportunity to tell you something about how De Laval makes sure you get *exactly* the *right machine* for your processing needs. Within reasonable limits, our engineers can predict how a material will behave under differing process conditions, but *only* within limits. When it comes right down to the line, every separation job and every processing operation is unique, capable of vital differences that can throw the whole process off if not taken into account beforehand.
"These panels deal with some of our methods for insuring dependable, predictable, and accurate results in processing with De Laval equipment. This is the story of how we make sure that you get *exactly what you need* every time you order De Laval Process Equipment."

**DESIGN AND APPLICATION TESTS GUARANTEE THE RIGHT CENTRIFUGE FOR YOUR OPERATION**

This is the De Laval Test Plant. It is here that the mechanical design of every new De Laval centrifuge is meticulously tested. Tests cover metal stress, mechanical wear, capacity and throughput pressures and other determinants of mechanical dependability in actual field operation. The tests are always more severe than the conditions for which the machine is designed. It is only when De Laval engineers are satisfied that the machine exceeds the performance standards at which it will be offered to industry that it is cleared for production.

Every mechanical modification of the machine will send it back through the same rigorous testing.

Related to the Test Plant is De Laval's Pilot Plant. With stages for mixing, reaction, heating, and three stages of separation, the Pilot Plant provides a complete centrifugal processing facility in which you can test your processes without having to build your own pilot plant. It is here, also, that De Laval engineers have developed complete processes replacing older methods and equipment. The next panel gives details on one of these developments, the patented De Laval Tall Oil System.

**For further information, write to De Laval.**

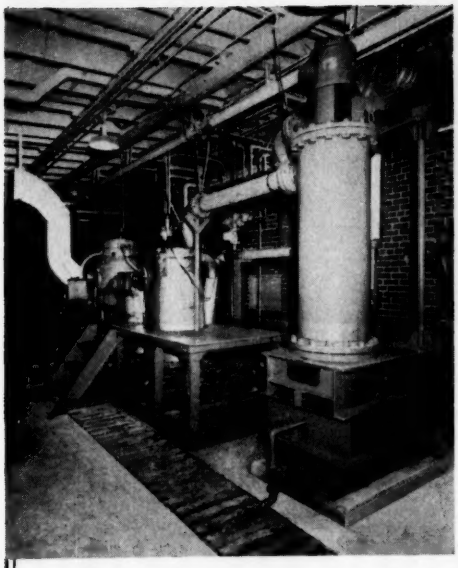
**DE LAVAL**

Dept. C-8

**THE DE LAVAL SEPARATOR COMPANY**
Poughkeepsie, New York
5724 N. Pulaski, Chicago 46, Illinois

**DE LAVAL PACIFIC COMPANY**
201 E. Millbrae Avenue, Millbrae, California

# GET EXACTLY THE MACHINE YOU NEED WITH DE LAVAL



**CONTINUOUS TALL OIL PROCESS...**
**HOW A PROCESS WAS ADAPTED**
**TO THE EQUIPMENT**
**WITH PHENOMENAL SUCCESS**

In developing the continuous Tall Oil Process, De Laval engineers adapted a process to equipment already at hand and made the operation more profitable with a better product, higher recovery and lower costs.

At the heart of the system, two De Laval AC-VO "Nozzle-Matic" centrifuges (illustrated above at St. Marys Kraft Corp., St. Marys, Ga.) continuously separate tall oil and concentrated salt cake liquor. This is the final stage of a 4-5 minute pass through the complete process. Note the contrast to the former batch method. Time required ran from 18 to 30 hours for a single batch and there was nothing like the control and certainty of the De Laval system.

Here is a case where a proven De Laval centrifuge was applied to a new process, developed through De Laval research. In this and other De Laval complete processes, De Laval's Pilot Plant and engineering staff have found a better way to make a better product at less cost.

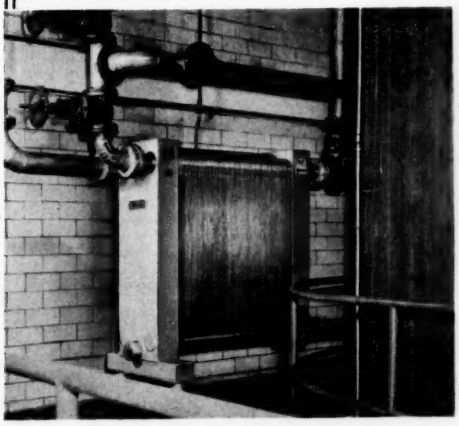
**RECOVERS AND RE-USES MORE THAN**
**12 MILLION BTU's PER HOUR**
**FROM NORMALLY WASTED SOURCE**

This De Laval Plate Heat Exchanger is doing an exceptional job for Finch, Pruyn & Company, Glens Falls, N. Y. Handling more than 110,000 lbs. per hour of 170° F spent sulfite liquor which was formerly dumped, it preheats 100,000 lbs. per hour of filtered river water.

The filtered water is preheated from 40°F to 150°F as it passes in juxtaposition to the spent sulfite liquor, which is cooled to a discharge temperature of 60°F.

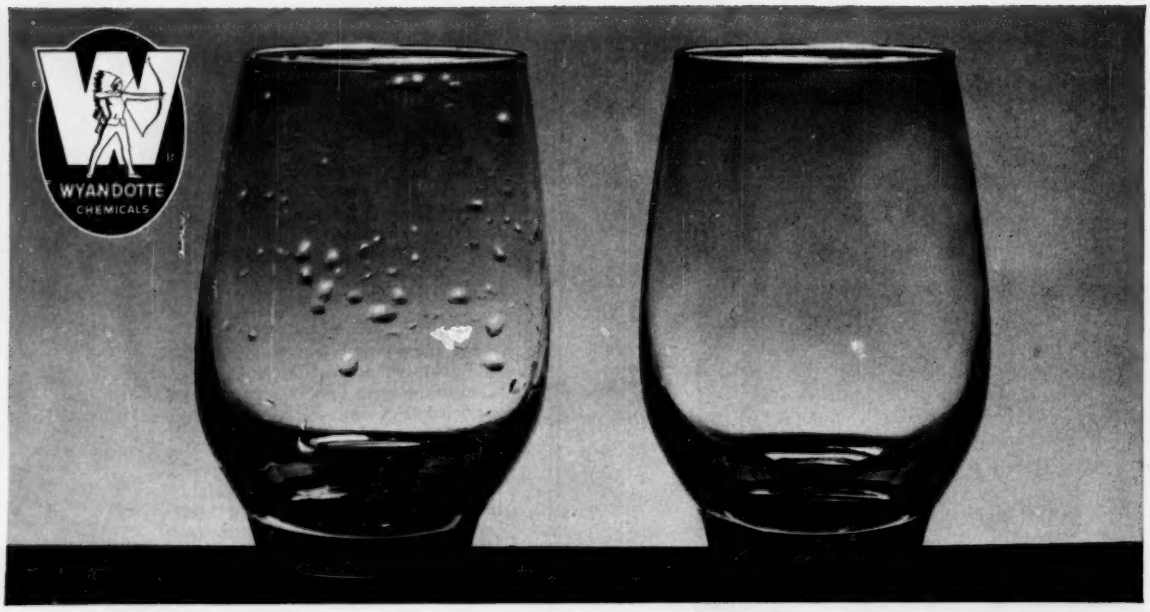
This highly profitable recovery of heat is accomplished in a remarkably small unit. Only 800 sq. ft. of heat transfer surface are required to recover the more than 12,000,000 BTU's per hour. Actual size of the unit is 11'8" x 2'9" x 6'2".

The amazingly high heat transfer coefficient of De Laval Plate Heat Exchangers makes heat recovery both *practical* and *profitable*. On the average, a De Laval Plate Heat Exchanger requires but one-fourth the transfer surface of a shell and tube exchanger operating at equal throughput capacity. And, a De Laval unit will perform to far more exacting standards, with greater efficiency.



# PROCESS EQUIPMENT

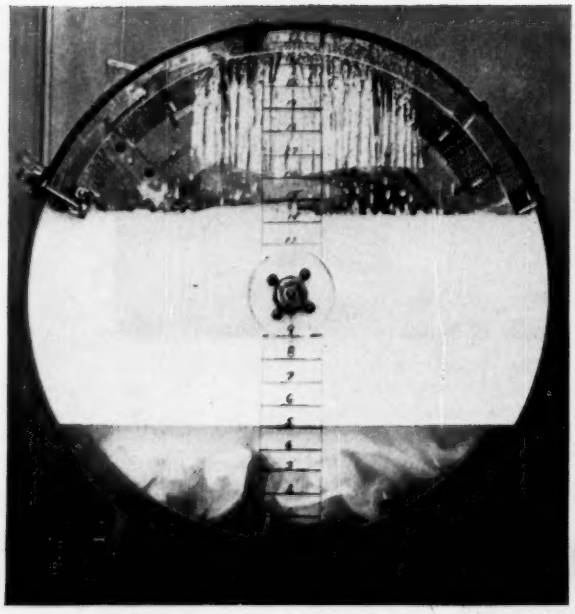
**CENTRIFUGES**
**PLATE HEAT EXCHANGERS**
**VIBRATING SCREENS**
**COMPLETE PROCESSES**

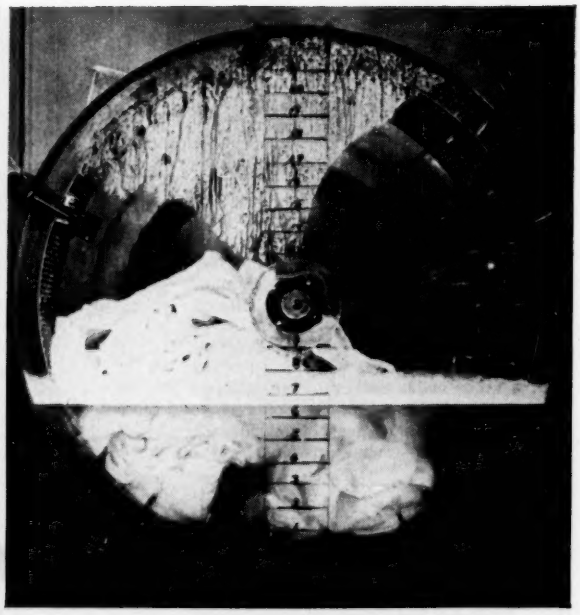



**PROBLEM:** To develop a rinse aid for mechanical dishwashing that will minimize water spotting and streaking, you need a surfactant with very low foam, good rinsing and wetting action.

**SOLUTION:** Pluronic polyols excel in all of these characteristics. In addition they have an extremely low order of toxicity. And rinse aids based on a Pluronic are easily formulated.

# Can Pluronic® polyols





**PROBLEM:** Formulators of home-laundry detergents must eliminate excessive foaming. But it is often difficult to reduce the foam to the desired level without a loss of detergency.

**SOLUTION:** Pluronic polyols offer *controlled* foaming, actually increase detergency! Systematic evaluation using the Pluronic Grid will determine the best grade for a specific formula.

**PROBLEM:** Starch-latex paper coatings require a stabilizer because starch and latex are incompatible. Casein can be used, but it raises the viscosity, must be cooked, can't be stored.

**SOLUTION:** When Pluronic L62 is used in place of casein, it actually reduces the viscosity of the coating! It requires no preparation, won't deteriorate, and acts as a foam depressant.

# make your product better?

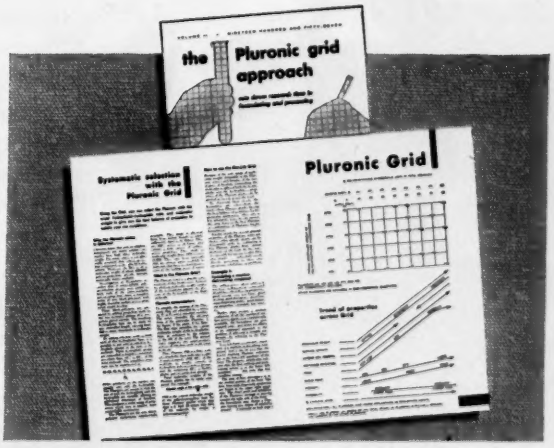
THERE'S a good chance they can . . . for very few chemicals offer the versatility of this unique series of patented block-polymers. Consider these facts:

Pluronic polyols exhibit a wide variety of surface-active properties. The series ranges in physical form from mobile liquids to pastes and solids sufficiently hard to be flaked . . . all forms are 100% active.

There are grades in the series having molecular weights of 1000 to more than 11,000. They vary from materials that are almost water insoluble to materials that have no cloud point—even at the boiling point of water.

These pictures show three typical uses of the Pluronic polyols. Actually, over 100 successful applications have been found so far, and the end is not in sight!

But the "proof of the pudding" is what the Pluronic polyols can do for *you*. For samples, technical data, and your copy of the Pluronic Grid, write us today. *Wyandotte Chemicals Corporation, Department 781-E, Wyandotte, Michigan. Offices in principal cities.*

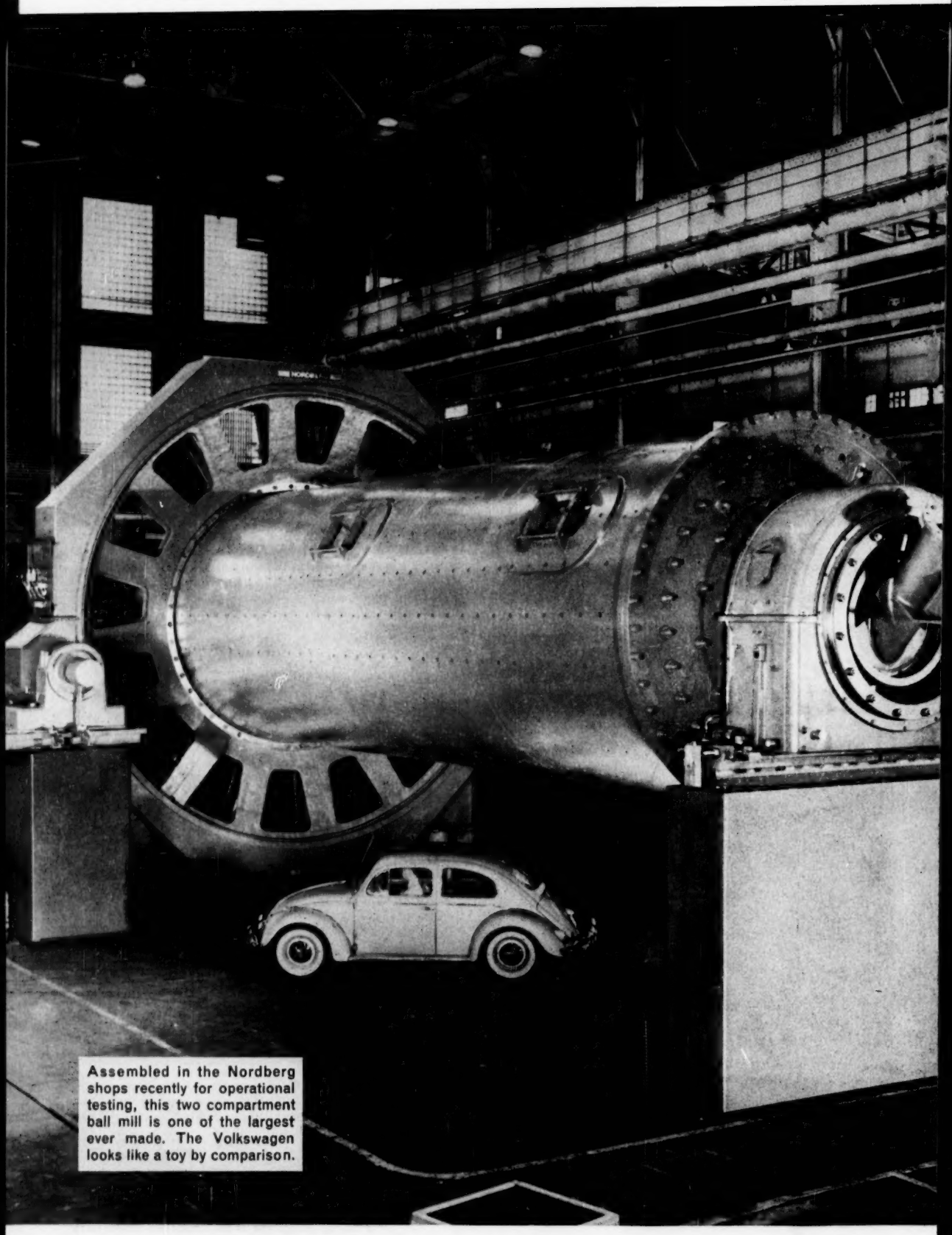



**The famous Pluronic Grid** provides a controlled, systematic method of screening . . . minimizes costly random investigation and evaluation by establishing related property trends between the grades available.

**Wyandotte CHEMICALS** MICHIGAN ALKALI DIVISION

*Pacing progress with creative chemistry*

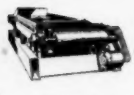
SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CARBONATE • CALCIUM CHLORIDE • CHLORINE • MURIATIC ACID • HYDROGEN • DRY ICE GLYCOLS • SYNTHETIC DETERGENTS (anionic and nonionic) • SODIUM CMC • ETHYLENE OXIDE • ETHYLENE DICHLORIDE • POLYETHYLENE GLYCOL • PROPYLENE OXIDE PROPYLENE DICHLORIDE • POLYPROPYLENE GLYCOL • DICHLORODIMETHYLHYDANTOIN • CHLORINATED SOLVENTS • OTHER ORGANIC AND INORGANIC CHEMICALS



Assembled in the Nordberg shops recently for operational testing, this two compartment ball mill is one of the largest ever made. The Volkswagen looks like a toy by comparison.

SYMONS PRIMARY GYRATORY CRUSHERS

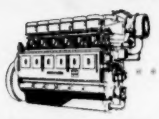
SYMONS® CONE CRUSHERS



SYMONS VIBRATING SCREENS

SYMONS VIBRATING GRIZZLIES

ROTARY KILNS and COOLERS



NORDBERG ENGINES

# NORDBERG sets the pace in LARGE GRINDING MILLS

## to turn out greater tonnages at lower cost per ton

Nordberg has recently completed five of the largest grinding mills ever built for industrial service. These two compartment Nordberg ball mills (see opposite page) are 12 feet in diameter by 36 feet long, each powered by a 2500 hp synchronous motor, operating at 10% beyond rating. These mills are being installed in a new 5 million barrel per year wet process cement plant. The economies of using very large grinding mills to turn out greater tonnages at lower cost are important, however, to many other large ore and mineral reduction processes, as well.

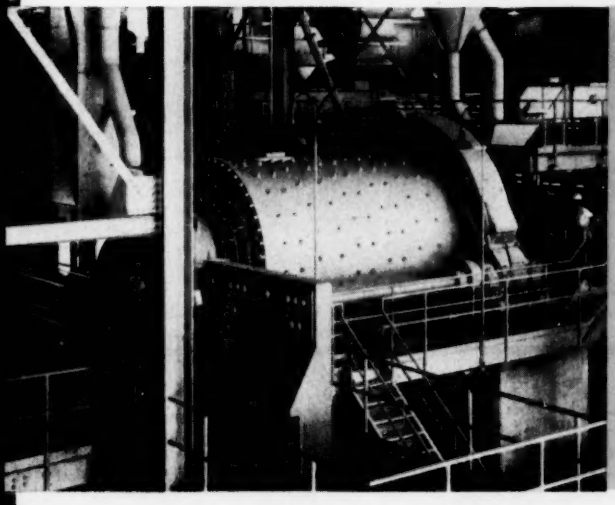
*Consider some of these basic advantages:*

1. *Lower construction and installation costs* . . . A single, large mill requires less floor space than several smaller ones, and only one foundation is required. Thus, construction costs are lowered and, in most cases, production is increased.

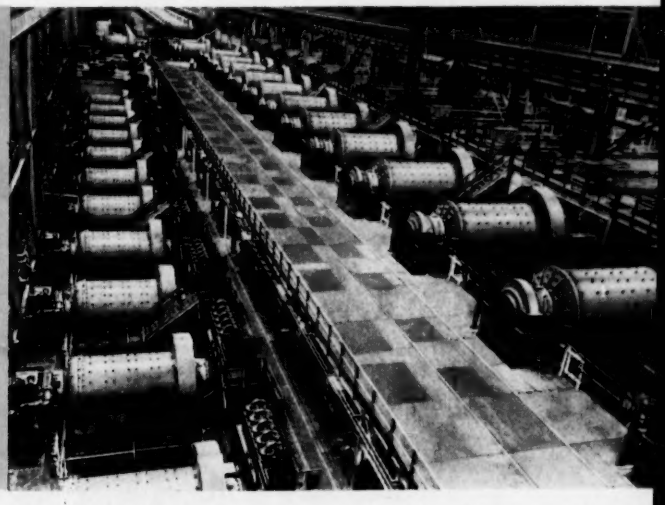
2. *Simpler automatic operation* . . . Where automatic operation is required, larger mills permit simpler handling with fewer controls. This lowers initial investment and minimizes installation and operational problems of automatic controls.

3. *Less maintenance* . . . Here, costs are again related directly to the number of mills installed. Fewer units mean less wearing parts and more dependable production. Exceptional savings may also be realized in replacement liners alone.

These are significant reasons behind the current trend toward larger grinding mills. But whether you require large or small grinding mills, you can count on the proven experience of Nordberg in furnishing the right grinding mill to meet your specific needs . . . including Rod, Ball, Pebble, Tube and Compartment types, in sizes from 6 to 13 feet in diameter and up to 50 feet in length. *Write for further information.*



Shown here are two of five 11′ x 17′ Nordberg Ball Mills—three raw and two finish—installed in a midwest cement plant that has a capacity of 3,000,000 bbl. annually.



The largest iron ore mill installation in the world with 58 Nordberg Grinding Mills. This concentrator building houses 27, 10′ x 14′ rod mills and 27, 10′ x 14′ ball mills. Four Nordberg mills serve as standby units.

**NORDBERG MANUFACTURING COMPANY, Milwaukee 1, Wis.**

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GM259

NORDBERG

*SYMONS . . . a registered Nordberg trademark known throughout the world.*

SYMONS SCREENS NORDBERG

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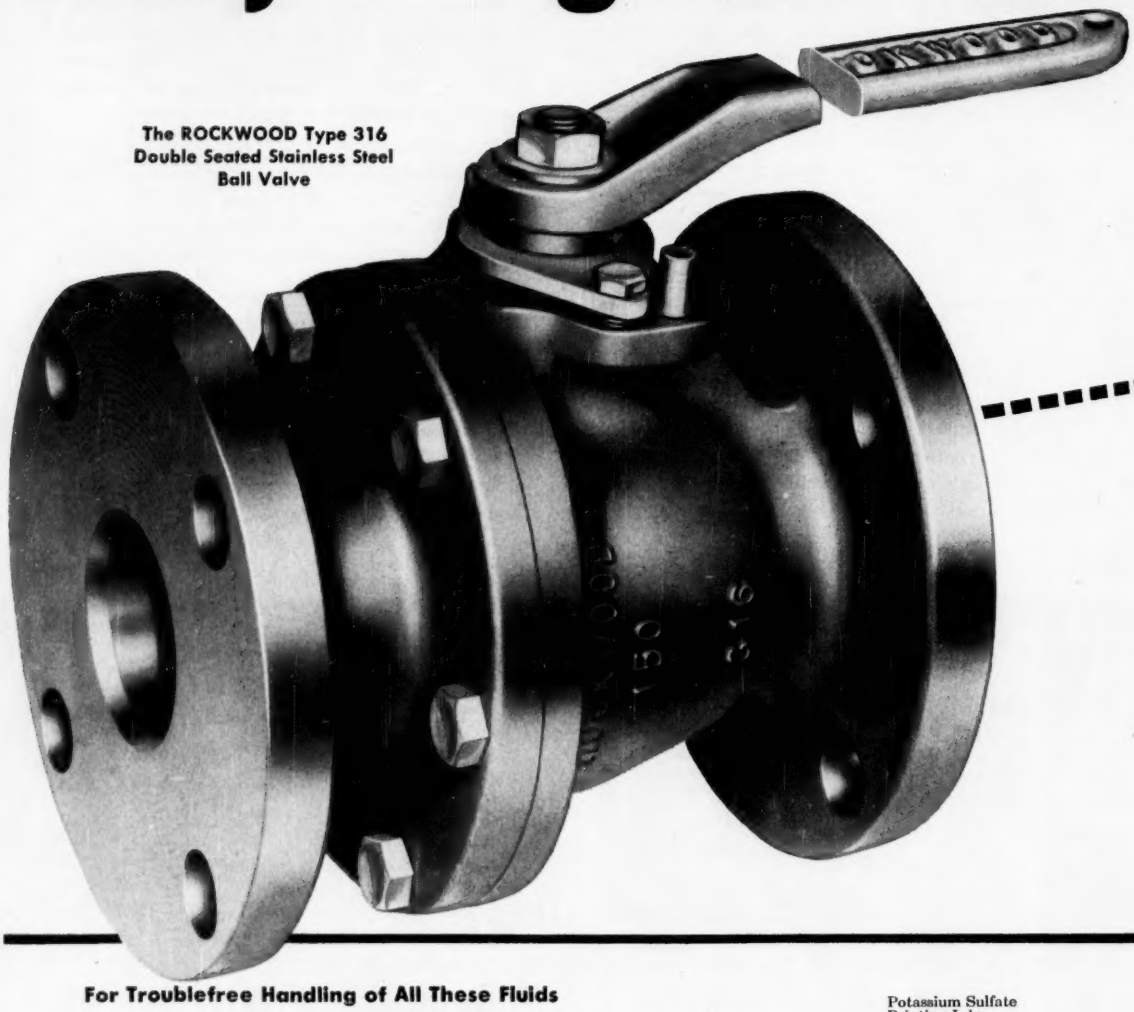
# NEW...

# Today's "Tightest" and



**The ROCKWOOD Type 316 Double Seated Stainless Steel Ball Valve**

**For Troublefree Handling of All These Fluids**

Air
Alcohols
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Beer (In Alcohol Industry)
Blue Vitriol; Copper Sulfate
Brines
Butane
Butanol; Butyl Alcohol
Calcium Sulfate
Cane Sugar Liquors
Carbon Dioxide (Dry Gas)
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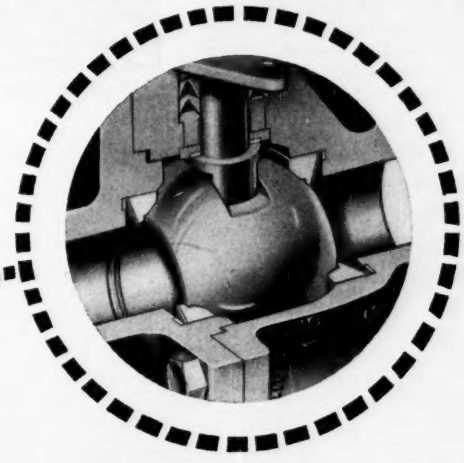
Cresylic Acid Dichloro-Difluoro-Methane; Freon
Corn Oil
Distillery Wort
Ethyl Ether & Diethylene Glycol
Epsom Salts
Ethyl Alcohol
Ethyl Sulfate
Ethylene Glycol Monobutyl Ether; Cellosolve
Fatty Acids
Foamite Solution Alkaline
Fruit Juices
Fuel Oil
Gases, Fuel
Gases, Hydrocarbon
Gases, Inert
Gases, Refrigerant
Gasoline Refined
Glaubers Salt
Glucose
Glycerine; Glycerol
Grain Alcohols
Helium
Hydrogen
Kerosene
Linseed Oil
Lubricating Oil
Magnesium Sulfate
Methane
Methanol
Mineral Oil
Mine Waters
Molasses
Neon
Oxygen
Pentane
Petroleum Oil
Potassium Sulfate
Printing Inks
Producer Gas
Propane
Propyl Alcohol
Return Condensate
Salt
Salt Cake
Salt Water; Sea Water
Sewage
Shellac
Sodium Sulfate
Sodium Carbonate
Soja (Soy) Bean Oil
Sweet Water
Tannery Liquors
Titanium Chloride
Vegetable Oils
Water
Water Glass

# Toughest Ball Valve!



"Spring Pressure Compensated"

Here's the new 316 stainless steel ball valve that not only gives you maximum corrosion resistance, but also *positive* assurance of leakproof service!

*It's Tightest* because exclusive spring rings back up its double Teflon* seats . . . *automatically* compensate for pressure variations, wear, cold-flow deformation and temperature effects. With flow in either direction . . . under vacuum or 600 psi . . . seats always hug the ball. Low-pressure leaks just can't occur!

*It's Toughest* because it's the only ball valve with integrally cast flanges or screw ends. They *stay* leakproof even under constant vibration.

The new double seated stainless steel valve also gives you all the famous features of other Rockwood Ball Valves: smooth, full round flow; easy ¼ turn opening and closing; dead tight sealing without lubrication; and many more.

For use at temperatures from −65°F to +350°F, it can be easily modified for cryogenics applications. Just as ideal for vacuum service too . . . holds tight after long, continuous service. Send coupon for details on today's most versatile corrosion-resistant ball valve.

**4 MODELS AVAILABLE- (Sizes ⅜" through 2")**

- 600 psi with screwed ends
- 150 lb. flanged to M.S.S. with standard 150 lb. face to face dimensions. Also available with 150 A.S.A.
- 300 lb. flanged to A.S.A. with standard 300 lb. face to face dimensions.

*DuPont Reg. Teflon seals include seats and adjustable chevron stem packing. Also available with nylon or synthetic rubber seals.

**ROCKWOOD BALL VALVES**

**ROCKWOOD SPRINKLER COMPANY**
*A Division of the Gamewell Company*
262 Harlow Street, Worcester 5, Massachusetts

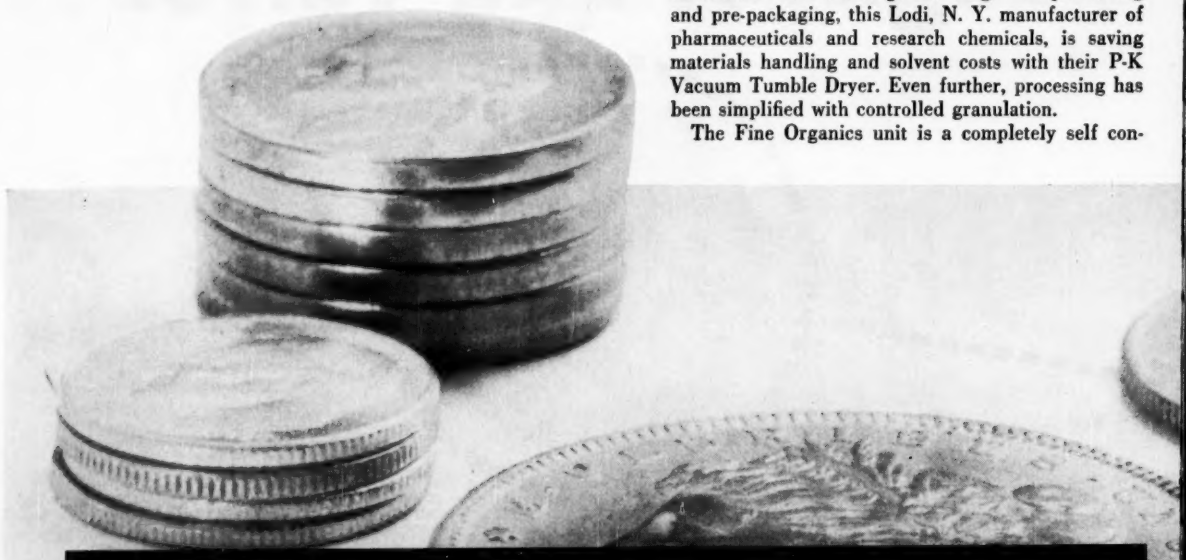
Please send full details on the new Type 316 Double Seated Stainless Steel Ball Valve.

*Name*..... *Title*.....
*Company*.....
*City*..... *Zone*..... *State*.....
.....

# EXCLUSIVE SAVINGS *at Fine Organics Inc.*

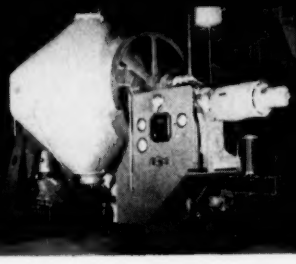
In addition to the savings resulting from pre-testing and pre-packaging, this Lodi, N. Y. manufacturer of pharmaceuticals and research chemicals, is saving materials handling and solvent costs with their P-K Vacuum Tumble Dryer. Even further, processing has been simplified with controlled granulation.

The Fine Organics unit is a completely self con-



**PRE-TESTED!** Future savings in vacuum tumble drying can be previewed at P-K's Vacuum Tumble Dryer Pre-Test Laboratory. Pre-testing realistically points the way to economies in drying time, solvent recovery, process simplification and handling costs. And it permits modification of controls, condenser, vapor line, receiver and other components to the individual needs of your process and product.

**PRE-PACKAGED!** Pre-packaging utilizes P-K's knowledge of companion equipment and parts. Units arrive completely assembled, fully balanced and ready for use. This eliminates costly, do-it-yourself trial and error during assembly and installation. It saves engineering time and overhead from design through purchasing and start-up. You can even see the difference! A neat compactness makes production areas look better.



## EXCLUSIVE COMBINATION!

Only P-K Vacuum Tumble Dryers offer pre-tested, pre-packaged savings. In pre-testing, results are predicted with a detailed procedure report and test samples. In pre-packaging, a single source of responsibility delivers a tailored, thoroughly proved assembly at a cost far less than a do-it-yourself project.

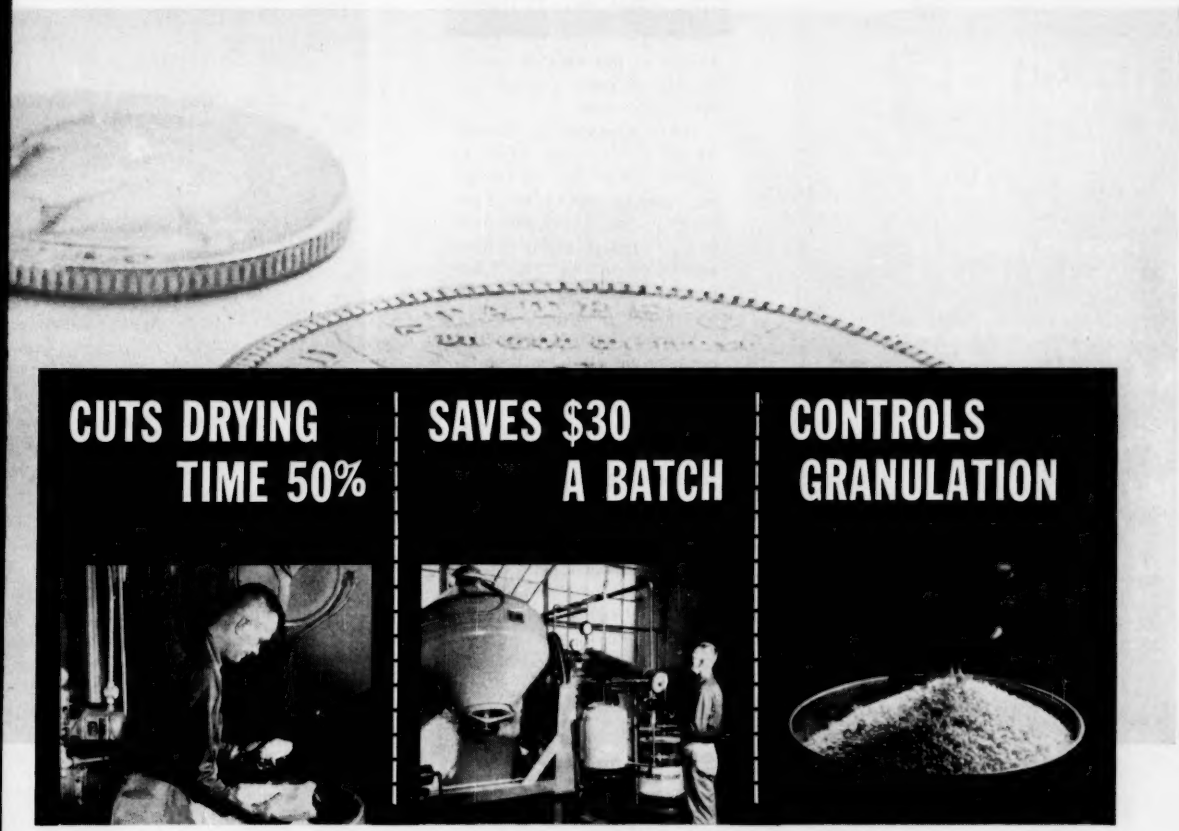
Compared to tray drying, the advantages of P-K Vacuum Tumble Dryers are overwhelming. Drying is many times faster. Expensive solvents are condensed and recovered. And caking that requires separate pulverizing and screening is eliminated. This greatly reduces handling. It often saves enough in labor costs to justify investment. It safeguards against product contamination.

Why not investigate P-K Vacuum Tumble Dryers more completely? We would also welcome an opportunity to tell you about our Liquid-Solids blenders. Our pre-test facilities are at your disposal. Send or bring your test material. For complete information call (Stroudsburg — Hamilton 1-7500) or write George Sweitzer at our East Stroudsburg Headquarters, 1508 Hanson Street. 178

# *with P-K Vacuum Tumble Dryers*

tained 20 cu. ft. dryer shown in the three photos below. It is used to dry chunks of a heat-sensitive waxy compound that contain 20-25% solvent. Open tray-type ovens were formerly used. After drying, the compound was conveyed to a pulverizer for sizing. Solvent was not recovered.

With the P-K Dryer, drying time is now 50% faster. Solvent recovery is 25 to 30 gallons per batch, averaging $30 in savings. This alone is expected to total $3,500 to $4,000 a year. Conveying and separate pulverizing is unnecessary because controlled tumbling action produces the desired pea-size granulation during drying. In other applications, particle size can be reduced to fine powders with a special P-K Intensifier Bar.




*pre-test your savings*

**Patterson Kelley**

**Chemical and Process Equipment Division**

**PATTERSON KELLEY CO., INC.**
**EAST STROUDSBURG, PENNSYLVANIA**

Please send technical literature on P-K Pre-packaged Vacuum Tumble Dryers and details of your offer to pre-test our use of them.

Name_____ Title_____

Company_____

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# Which of these 5 products and services can you use... from

And Arnel, too, for that matter. As well as rayon-acetate, and other synthetics.

What's made for them? Becco's Peracetic Acid, of course. It's perfect for bleaching many synthetics, since you get good clear whites with practically no reversion during heat-setting operations. You'll find Becco Peracetic Acid minimizes reversion in storage, too.

We say "many" synthetics, because we can't list them all here. If you're having trouble bleaching any particular one, why not write us? We'll tell you what we've done to date, and what we might be able to work out for you.

If you're finishing nylon, start off by getting your free copy of Becco Bulletin No. 60 —"Successful Bleaching of Types 670 and 200 Nylon with Peracetic Acid."

Use the coupon below.

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**Becco Chemical Division**

STATION B, BUFFALO, NEW YORK

**BECCO CHEMICAL DIVISION, FMC**
**Station B, Buffalo 7, New York**

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Gentlemen:
Please send me a copy of your free Bulletin No. 60—"Successful Bleaching of Types 670 and 200 Nylon with Peracetic Acid."

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## Need a Bleach Plant in a hurry?

By now, you've probably heard about Becco's Dryer Steep Bleaching Process for insuring brightness permanence by spraying Hydrogen Peroxide across the pulp sheet ahead of the dryers. And you probably know that although the process is patented, Becco will grant a perpetual license for just $1.00.

But there may still be a question in your mind as to how you can prove this out in your own mill—how you can set up a bleach plant in a hurry.

Becco has the answer to this, too. We'll be glad to provide you with a complete "bleach-plant kit"—for as long as you need it—consisting of all the equipment needed to make up peroxide bleach liquor and spray your production sheet.

Here's an opportunity for you to prove to yourself, quickly and easily, that this Becco process will maintain your layboy brightness level — even **improve** it — through shipping and delivery.

If you'd like to take us up on this offer, drop us a line, or mail the coupon below. And of course, even after we demonstrate, you incur no obligation.

BECCO fmc

**BECCO CHEMICAL DIVISION, FMC**
**Station B, Buffalo 7, New York**
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Gentlemen:

Yes! We need a "bleach plant in a hurry". Please send us more information about Dryer Steep Bleaching.

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FIRM_____

ADDRESS_____

CITY_____

ZONE_____ STATE_____

## TECHNICAL BULLETINS DESCRIBING $H_2O_2$

**We got 'em—**
**You can have 'em—**
**They're FREE!**

Years of experience in working with Hydrogen Peroxide have produced a wealth of information on this valuable compound, its properties, and reactions. Much of this information is available virtually exclusively from Becco. We've compiled a number of Technical Bulletins, which are yours free on request. Simply decide which ones you want, and mail the coupon below.

**No. 2**—Hydrogen Peroxide (general information)

**No. 41**—Becco $H_2O_2$ 35% HP (high purity)

**No. 42**—Becco $H_2O_2$ 35% Formula D (for preparing dilute solutions)

**No. 46**—Concentrated $H_2O_2$ (over 50% concentration)

**No. 70**—Becco Hydrogen Peroxide SP "100" (Super Pure, of virtually 100% concentration.)

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**BECCO CHEMICAL DIVISION, FMC**
**Station B, Buffalo 7, New York**
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Gentlemen:

Please send me the free Technical Bulletins checked below:

☐ #2 ☐ #41 ☐ #42 ☐ #46 ☐ #70

NAME_____

FIRM_____

ADDRESS_____

CITY_____

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## Where can you use these *other* Becco PEROXIDES?

By "other", we mean "Other than Hydrogen Peroxide". Lots of otherwise knowing people labor under the impression that Becco makes only $H_2O_2$. Actually, there are quite a few "other" useful peroxides in Becco's catalog, some of which are especially suited to high-temperature oxidation reactions.

Look over the list below. Give you ideas? Remind you of a problem you've got? Either way, a note to Becco will bring you more information. Or, use the handy coupon.

**UREA PEROXIDE**—for use in hair dyeing and cold waving, disinfectants, hypo eliminators, and as a source of water-free $H_2O_2$.

**SODIUM CARBONATE PEROXIDE**—for compounding detergents and adhesives.

**SODIUM PERBORATE**—for use in dyestuff development, detergents, tooth-powders; as a mild bleaching agent and cold wave neutralizer.

**CALCIUM PEROXIDE**—for dough conditioning and in high-temperature oxidation reactions.

**MAGNESIUM PEROXIDE**—an antifermentative, for compounding antacids and laxatives.

**ZINC PEROXIDE**—for use as a disinfectant and deodorant in dusting powders, ointments, etc.

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Gentlemen:

Please send me

☐ Becco Bulletin No. 1—"Active Oxygen Chemicals".

☐ Detailed information on _____

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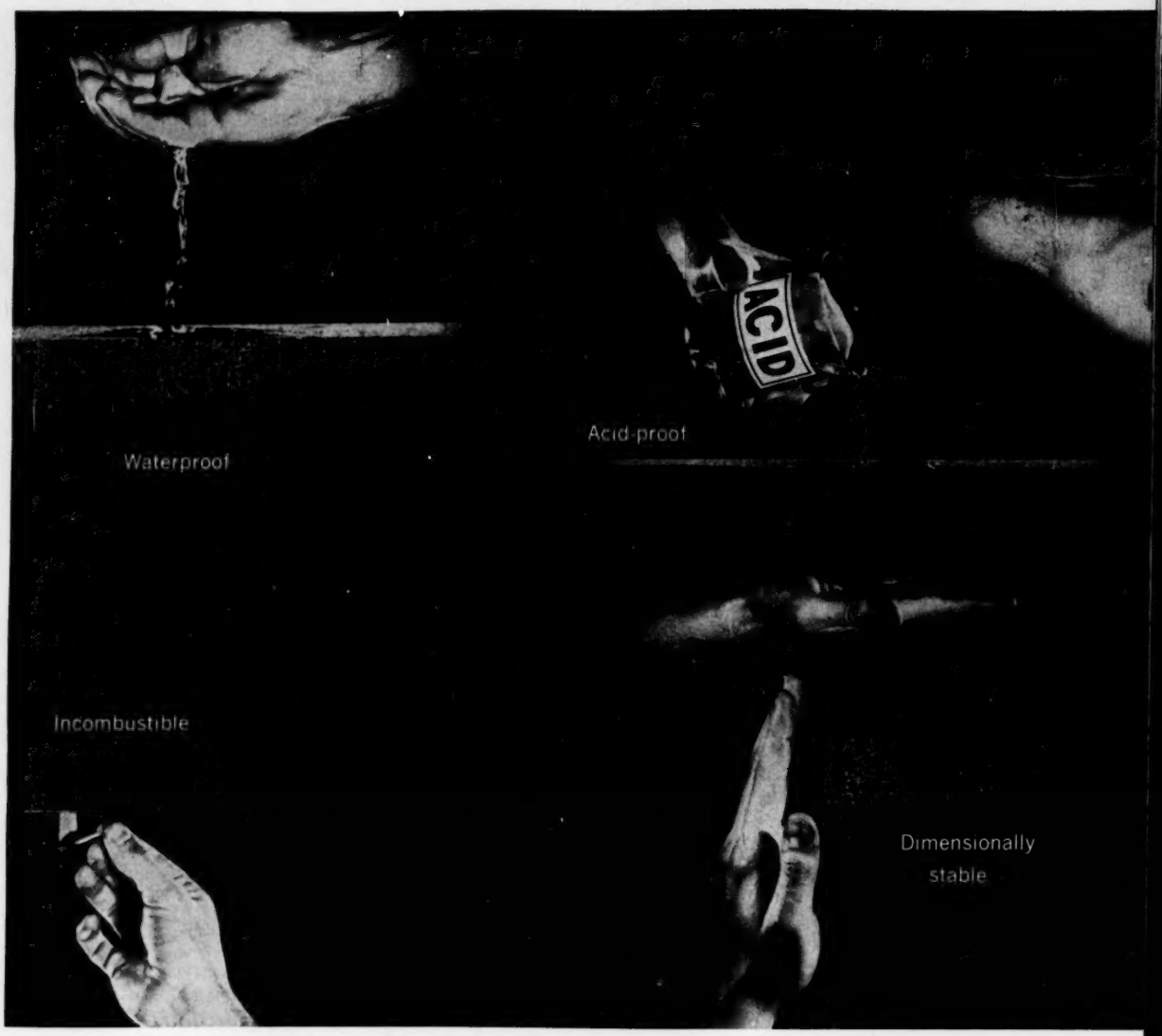


# only FOAMGLAS® insulation hands you takes guesswork out of

Don't gamble on the insulation for your piping and equipment. You'll find most insulations deliver just a few of the performance benefits your operating conditions call for. FOAMGLAS, on the other hand, is a unique cellular glass insulating material that hands you an unmatched combination of benefits to cover all your insulating bets.

Does your process generate vapor? Is humidity high in your area? Spillage a problem? No need to worry. FOAMGLAS is completely impervious to liquids and vapor. Its insulating effectiveness stays constant

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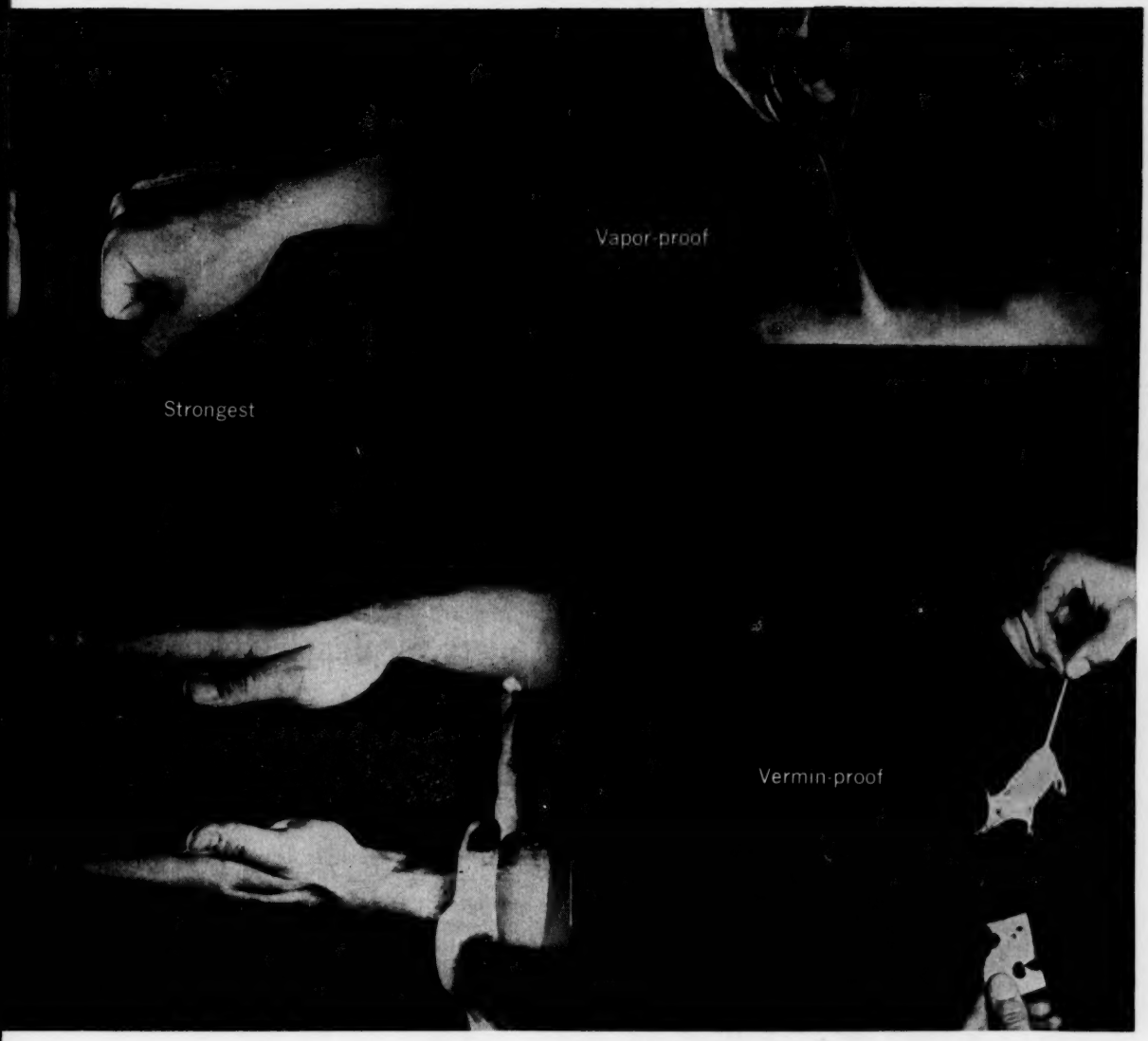



# *all these benefits in one material . . . insulating piping and equipment*

no matter how wet your operating environment may be.

Fire hazard? Forget it. FOAMGLAS can't burn.

Is the insulation ever exposed to acids? No problem at all. FOAMGLAS is acid-proof.

Physical strength? FOAMGLAS is completely rigid and has an average ultimate compressive strength of more than 7-tons per sq. ft.

No danger of gaping joints in the insulation, either. Not with FOAMGLAS. It's dimensionally stable . . . won't shrink, swell, warp, or slump.

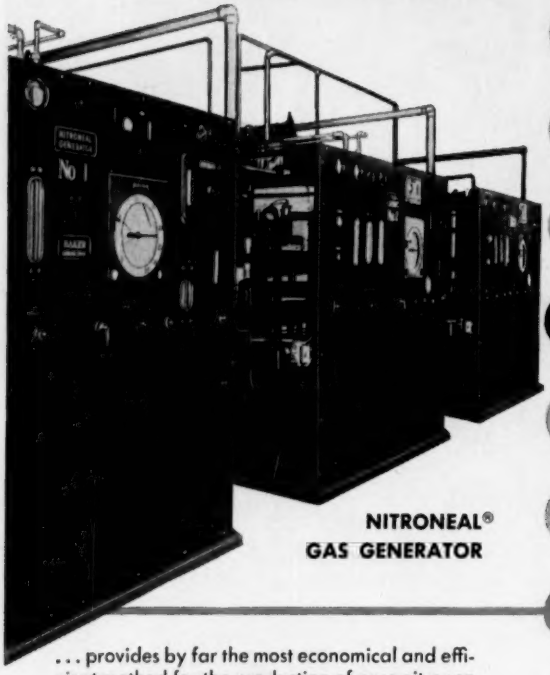
And just in case you've been troubled with rodents, you'll be glad to know that inorganic FOAMGLAS is vermin- and rodent-proof.

Whatever your pipe or equipment insulation problem, you're sure to find in FOAMGLAS the long lasting, no-risk solution you've been looking for. Get complete details in our Industrial Insulation Catalog.

For your free copy, write today to Pittsburgh Corning Corporation, Department H-89, One Gateway Center, Pittsburgh 22, Pennsylvania.

PC CORNING

# for the most efficient production of oxygen-free gas



**NITRONEAL® GAS GENERATOR**

. . . provides by far the most economical and efficient method for the production of pure nitrogen —*completely free of oxygen*—and with hydrogen content precisely controlled at any desired percentage between 0.5% and 25%. Nitrogen is supplied at a fraction of cylinder supply cost.

The Nitroneal Generator is automatic except for startup, with no need for operating personnel. The unit performs instantly, efficiently anywhere in the range of from 25% to 100% of rated capacity. Installation requires only a 110 volt line, water, air, ammonia lines and drain facilities. Units can be supplied in capacities of 100 cfh to 10,000 cfh. . . . The catalyst lasts indefinitely—maintenance costs are practically nil. Write for complete catalog material and data.

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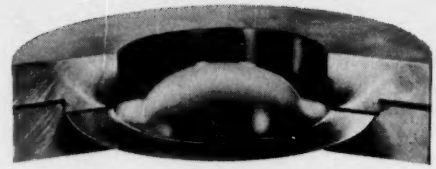

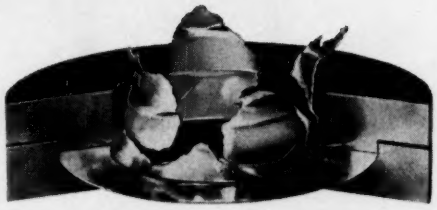

# corrosion-resistant rupture discs for dependable instant and automatic relief of excess pressure

In pressurized apparatus subject to corrosive action, precious metal rupture discs provide the safest, most accurate and dependable relief. Platinum, gold, and silver are now generally recognized as specifics when dealing with corrosion. Each is resistant to the corrosive effects of an important group of liquids and gases and will remain unattacked under conditions that would render many base metal materials useless. These rupture discs, depending on material selected, are guaranteed to be burst ± 5% of specified pressure. Intrinsic value adds to the original cost of these discs but the actual metal value is recovered, no matter how torn or battered the discs may be. Send for Bulletin.

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# these platinum catalysts simplify product production control

For highest levels of purity . . . definite economy and simplified, accurate production control, the platinum metals catalysts are unique. In the production of high-purity chemicals, pharmaceuticals, vitamins and biotics, their efficiency is unmatched by any other type of catalyst. Here, the world's largest facilities and broadest experience in the development and manufacture of platinum metals catalysts are at your service. A representative will be glad to confer with you, in strictest confidence, of course, or if you prefer, send for brochure "THE ROLE OF THE PLATINUM GROUP METALS AS CATALYSTS."

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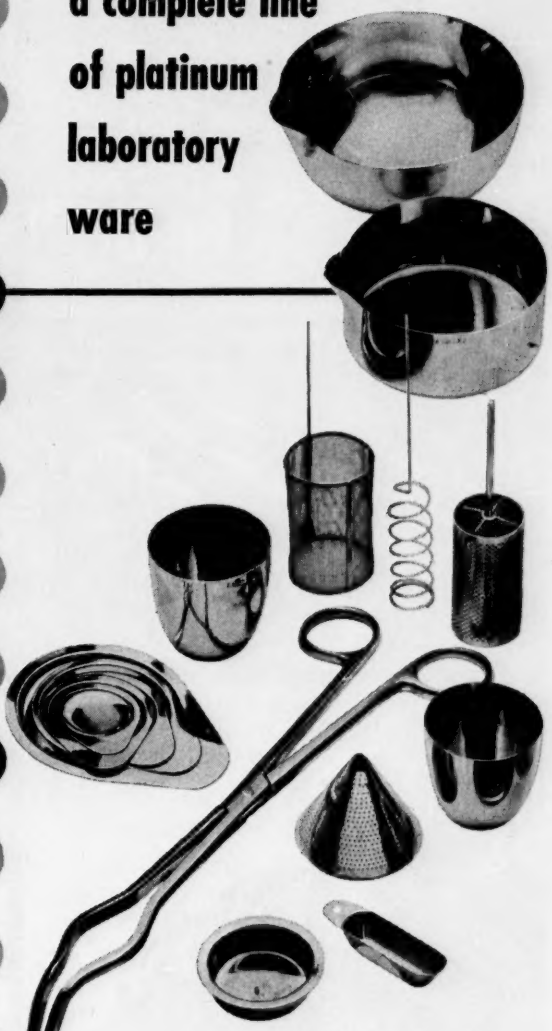
# a complete line of platinum laboratory ware



All standard forms and sizes for chemical and physical purposes, made of platinum or any desired alloy. Line includes crucibles, reshapers, triangles, dishes, electrodes, anodes and cathodes. A catalog is available upon request.

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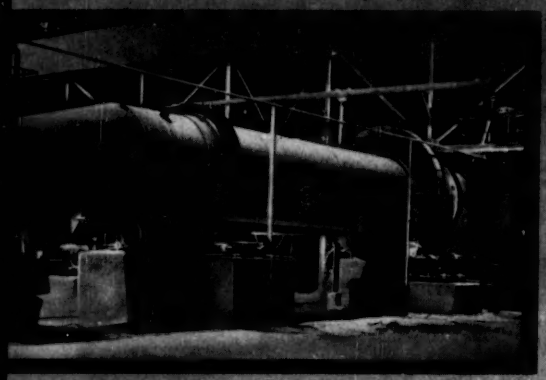
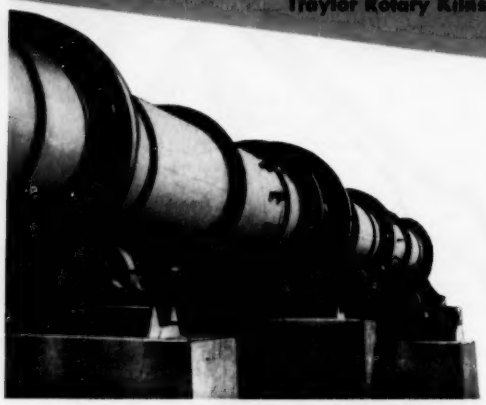
# Traylor-made kilns and slakers

## Advanced design for operating economy

13'—0" dia. to 10'—0" x 200'—0" Traylor Rotary Kilns.



Traylor Slakers in a chemical plant.



8'—0" x 300'—0" Rotary Kiln in a paper plant.

Hundreds of Traylor Rotary Kilns and Slakers are in daily use by the processing industries throughout the world. The long history of successful operation of Traylor machinery is assurance that your machine problem will be handled efficiently and expertly by Traylor engineers. For additional information on these fine Traylor products, write for Bulletin No. 1115 today.

6'—0" x 57'—0" Slaker in a paper plant.

GYRATORY CRUSHERS • JAW CRUSHERS
Traylor
ROTARY KILNS • BALL MILLS • APRON FEEDERS

**ENGINEERING & MFG. CO.**

**1180 MILL ST., ALLENTOWN, PA.**

Sales Offices: New York — Chicago — San Francisco

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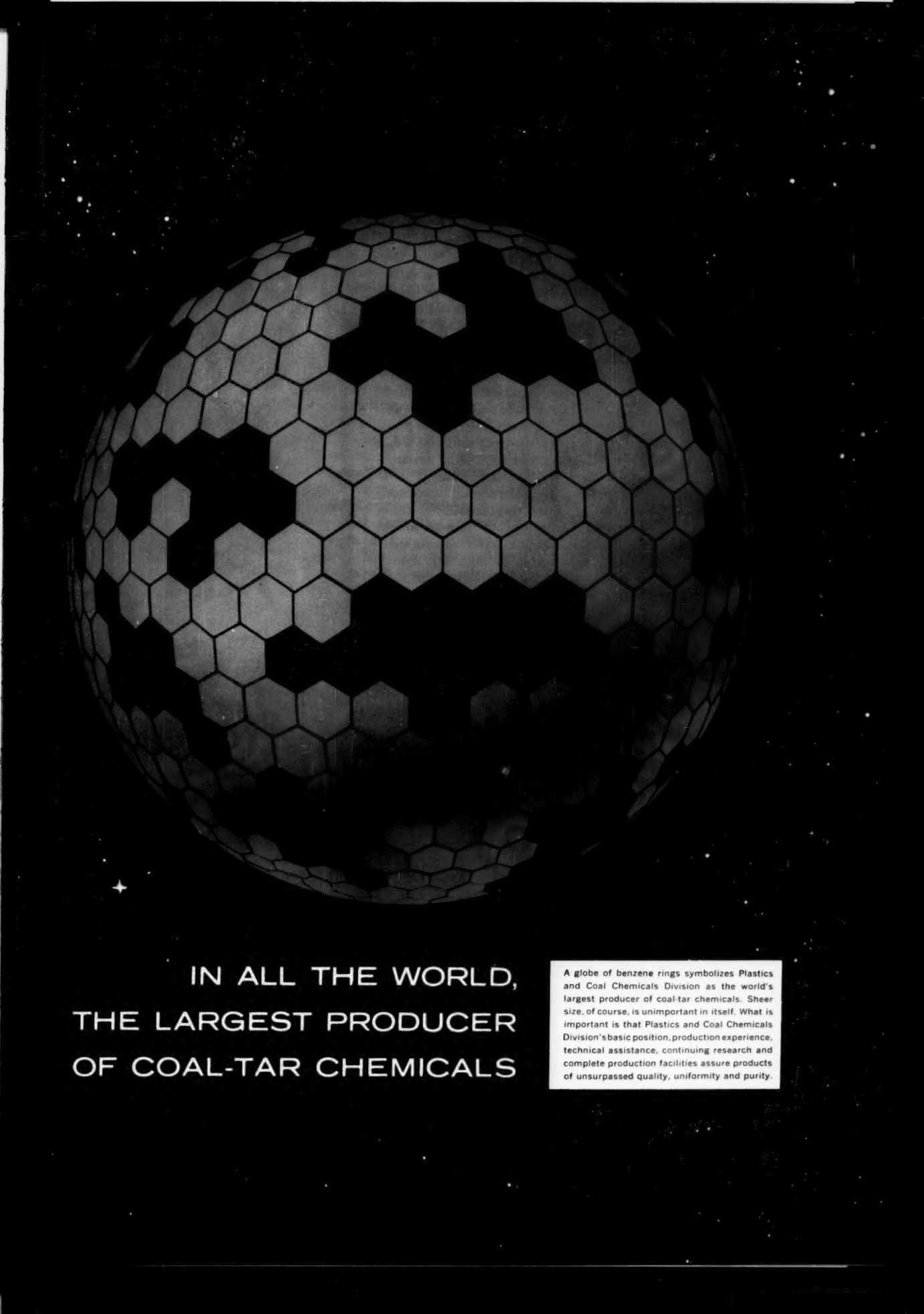


# IN ALL THE WORLD, THE LARGEST PRODUCER OF COAL-TAR CHEMICALS

A globe of benzene rings symbolizes Plastics and Coal Chemicals Division as the world's largest producer of coal-tar chemicals. Sheer size, of course, is unimportant in itself. What is important is that Plastics and Coal Chemicals Division's basic position, production experience, technical assistance, continuing research and complete production facilities assure products of unsurpassed quality, uniformity and purity.

Coal-tar chemicals offer a world of opportunity to development chemists and process engineers alike. On these pages, the world's largest producer, Plastics and Coal Chemicals Division of Allied Chemical, describes some that have long been staples of chemical processing, others that are commercially new

## PHTHALIC ANHYDRIDE

The synthesis of phthalic anhydride by the catalytic air oxidation of naphthalene vapor is a notable example of progressive chemistry and engineering. Today, hundreds of millions of pounds are being produced annually for use in the plastics, coatings, drug and dye industries, with new and commercially valuable applications being constantly discovered. As the world's largest producer, Plastics and Coal Chemicals Division is particularly qualified to serve your PA needs. Distinctive purification procedures embodying the latest technological advances, plus continuing research and application studies have resulted in a uniform product of unsurpassed excellence. Fast, dependable delivery is assured from plants in three strategically located areas. Plastics and Coal Chemicals Division Phthalic Anhydride is available in both liquid and flake forms, whichever best suits your convenience.

*Photomicrograph shows phthalic anhydride, magnified 15 times, crystalized from the liquid state. By the method of calorimetric freezing point determination, Plastics and Coal Chemicals Division commercial phthalic anhydride measures 99.7 mole % pure (minimum), opening a new age of confidence for PA users.*

## INDUSTRIAL AROMATIC SOLVENTS

Plastics and Coal Chemicals Division of Allied Chemical has led the way in establishing standard testing methods and specifications for light oil distillates. This work has paid off in the higher reliability of Allied Chemical Aromatic Solvents.

| | |
|---|---|
| Benzol, Nitration | Xylol, Nitration |
| Benzol, Industrial Pure | Xylol, Ten Degree |
| Benzol, Industrial 90% | Xylol, Industrial |
| Benzene, Thiophene-free | Hi-Flash Solvent |
| Toluol, Nitration | 1320 Oil |
| Toluol, Industrial Pure | Wire Enamel Solvent |

All available in Tank Cars and Tank Trucks

## PHTHALONITRILE

A high purity, aromatic, organic intermediate offered for the first tim in the United States by a domestic producer. Phthalonitrile has an exceptionally stable aromatic ring which resists chlorination, sulfonatio and nitration unless the cyano groups have been chemically change or modified. In addition to its conversion to pigments, phthalonitri is a starting material for dye intermediates, metal coatings and high-temperature lubricants.

## TAR BASES

This special class of refined coal chemicals includes pyridine, quinoline and related compounds. Many recent developments indicate that their potentials in the field of industrial chemistry are just beginning to be fully realized.

| | |
|---|---|
| Refined Pyridine 2A | Refined Alpha Picoline 2A |
| Pyridine 10A | Refined Beta Gamma Picoline |
| Pyridine 15A | Refined Quinoline |
| Mixed Picolines 20A | Refined 2,4 Lutidine |
| Pyridine 30A | Special Refined Grades |
| Mixed Lutidines | Special Fractions |
| Tar Bases 50A | |

## ANTHRACENE

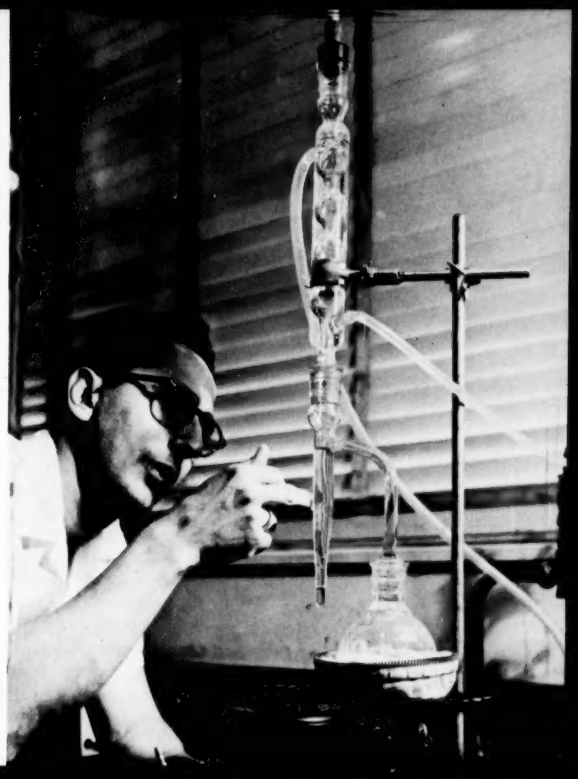
Now available commercially from a domestic source, anthracene undergoes both the Diels-Alder and Friedel-Crafts reactions . . . can be reduced, nitrated, sulfonated and reacted with halogens . . . has remarkable photosensitive propertie With Plastics and Coal Chemicals Division Anthracene (90–95% purity) as a starting point, you hav a wide selection of functional groups leading to commercially valuable products.

and now ready to be exploited into valuable products. Plastics and Coal Chemicals Division is always ready to help you make wider and more profitable use of all its products—while continually developing new items to keep pace with a fast-moving economy and serve your ever-changing needs.

PLASTICS AND COAL CHEMICALS DIVISION OF ALLIED CHEMICAL CORPORATION

## PHENOL, USP (synthetic)

Synthetic phenol is a valuable basic raw material for the manufacture of dyestuffs, chemicals, medicinal products and phenol-formaldehyde resins and for refining of lubrication oils, with potentialities that are still far from being fully realized. Plastics and Coal Chemicals Division synthetic phenol is available as a crystalline solid made to specifications even more exacting than those required for the U.S. Pharmacopeia grade, and in liquid form in phenol strengths of 92 and 85 percent. These liquefied phenols are prepared simply by adding to USP grade crystals distilled water. Time-tested standardization procedures assure excellent uniformity, and you can order prompt shipments by tank car or tank truck. Only Plastics and Coal Chemicals Division can supply you with *every grade of phenol*—both synthetic and natural—another reason why it pays to deal with the leader.



*Determination of water in phenol by azeotropic distillation. Plastics and Coal Chemicals Division Phenol, USP, and other tar acids are standardized with a thoroughness that assures you complete reliability.*

## ELASTEX* PLASTICIZERS

Plastics and Coal Chemicals Division carefully controls the manufacture of "ELASTEX" Plasticizers to insure shipment of materials meeting the most stringent customer specifications. Those liquid in form can be shipped to you by *express* tank truck from any of 12 strategically located tank stations.

Dibutyl Phthalate*
Dimethyl Phthalate*

| | |
|---|---|
| "ELASTEX" DCHP Plasticizer— | Dicyclohexyl Phthalate |
| "ELASTEX" 10-P Plasticizer*— | (Diisooctyl Phthalate) (DIOP) |
| "ELASTEX" 28-P Plasticizer*— | Di-2-Ethylhexel Phthalate (DOP) |
| "ELASTEX" 18-P Plasticizer*— | Isooctyl Isodecyl Phthalate |
| "ELASTEX" 20-A Plasticizer*— | Diisodecyl Adipate |
| "ELASTEX" 40-P Plasticizer*— | Butyl Isodecyl Phthalate |
| "ELASTEX" 48-P Plasticizer*— | Butyl Octyl Phthalate |
| "ELASTEX" 50-B Plasticizer*— | Butyl Cyclohexyl Phthalate |
| "ELASTEX" 60-A Plasticizer*— | Di-2-Ethylhexyl Adipate |
| "ELASTEX" 82-P Plasticizer*— | Normal Octyl—Normal Decyl Phthalate |
| "ELASTEX" 90-P Plasticizer*— | Diisodecyl Phthalate |
| "ELASTEX" 36-R Plasticizer— | Medium molecular weight polymeric plasticizer |
| "ELASTEX" 37-R Plasticizer— | High molecular weight polymeric plasticizer |
| Plasticizer 136*— | An aryl alkyl hydrocarbon |

*Available in Tank Cars or Trucks

## TECHNICAL PHENOLS, CRESYLIC ACIDS, CRESOLS & XYLENOLS

The phenols obtained from coal-tar distillates comprise a valuable group of manufacturing chemicals—the tar acids. Plastics and Coal Chemicals Division has specialized in the production of refined acids to exacting specifications. Its standardization methods insure completely reliable products. Among them, you will find acids to the exact degree of refinement you require.

**Phenols-Synthetic & Natural**
Technical Phenol (all grades)
Phenol-Cresol Mixes
Phenol-Cresylic Mixes

**Cresylic Acids**
Mixtures of close-cut fractions blended to meet particular commercial requirements
Special Engine Cleaning Grades

**Cresols**
Cresol, USP
Ortho Cresol (ranging from 50% to 98+% purity)
Metaparacresols
Resins Cresols
Special Cresol Fractions blended to order

**Xylenols**
Metaxylenol —45°C., 56°C. and 61.2°C. Min. M.P.
Crude and Refined Grades
Special Fractions

GET THE LATEST INFORMATION ON COAL-TAR CHEMICALS FROM THE LEADER—

For the convenience of purchasing people in specific chemical industries, we have compiled helpful product data on an industry-by-industry basis. You can have this data by filling out the coupon below, telling us in which industry you work. You'll find it an important assist in keeping all our resources at your fingertips.

PLASTICS AND COAL CHEMICALS DIVISION
40 Rector Street, New York 6, N. Y. In Canada:
Allied Chemical Canada, Ltd.,
1450 City Councillors St., Montreal

Allied Chemical

## NAPHTHALENE

Comes in six convenient forms: ball, flake, ring, chipped, crushed and liquid. Tailored to meet all requirements for manufacturing of insecticides, tanning agents, dyestuff intermediates, pharmaceuticals, phthalic anhydride and other industrial chemicals. Crude naphthalene also available in tank cars and tank trucks.

## ACETONE

A high-purity product derived from the Cumene-Phenol Process. Recommended as an intermediate in chemical and drug manufacture and for use as a solvent. Acetone promises to become increasingly important in the plastics field as a basic chemical in the manufacture of epoxy resins. Fast delivery by tank car or tank truck is assured from supply depots at Boston, Chicago, Cleveland, Detroit, Los Angeles, New York and Philadelphia. Drum stocks only at Charlotte, N. C. and St. Louis, Mo.

## NIACIN USP

The finest Niacin available, produced to meet the rigid requirements necessary for manufacturing of pharmaceuticals, animal and poultry feeds and the enrichment of flour. Blends with soy flour available for the blending of vitamin premixes. Produced to meet the highest standard of purity through basic position in raw materials and the most modern equipment—conforms to USP specifications. Can be ordered from our manufacturing plant in Philadelphia and warehouses at Los Angeles and Chicago.

## CUMAR® RESINS

One of the earliest developments in synthetic resins, these paracoumarone-indene resins continue to find broad markets in a multitude of industries. They are available in nine separate grades for use in varnishes, floor tile, natural and synthetic rubber products, printing ink, adhesives and water-proofing materials. Also used in the leather, electrical, radio, and paper industries.

## ALPHA-METHYL STYRENE

A low cost unsaturated aromatic monomer produced from a cumene-phenol operation in a 99.5+ % pure grade. Alpha-methylstyrene reacts more slowly and exhibits much less of a tendency to homopolymerize. It will, however, homopolymerize in the presence of an ionic catalyst. In addition alpha-methylstyrene will copolymerize with a wide variety of unsaturated chemicals including butadiene, acrylonitrile, isobutylene, vinylidene chloride, terpenes, acrylates, methacrylates, and most vinyl monomers.

## OTHER CHEMICALS & PRODUCTS

- Maleic Anhydride
- Fumaric Acid
- Resin S (A neutral synthetic resin of high styrene content)
- Specialized Rubber Compounding Materials
- "A-C" Polyethylene Lubricants
- Cyclohexanol
- Cyclohexanone
- Methanol
- Acetophenone
- Ethylbenzene
- Cumene
- Cumylphenol
- Ethylene Glycol
- Diethylene Glycol
- Monoethanolamine
- Diethanolamine
- Triethanolamine
- Flotation Agents
- Pickling Inhibitors
- Tar Distillates
- Tar Acid Oils

**PLASTICS AND COAL CHEMICALS DIVISION**
ALLIED CHEMICAL CORP., 40 Rector Street,
New York 6, N. Y.

Please send me specific product data for:

- ☐ Rubber Industry
- ☐ Paint Industry
- ☐ Plastics Industry
- ☐ Soap and Specialties Industry
- ☐ Technical data and laboratory samples of_____for investigation

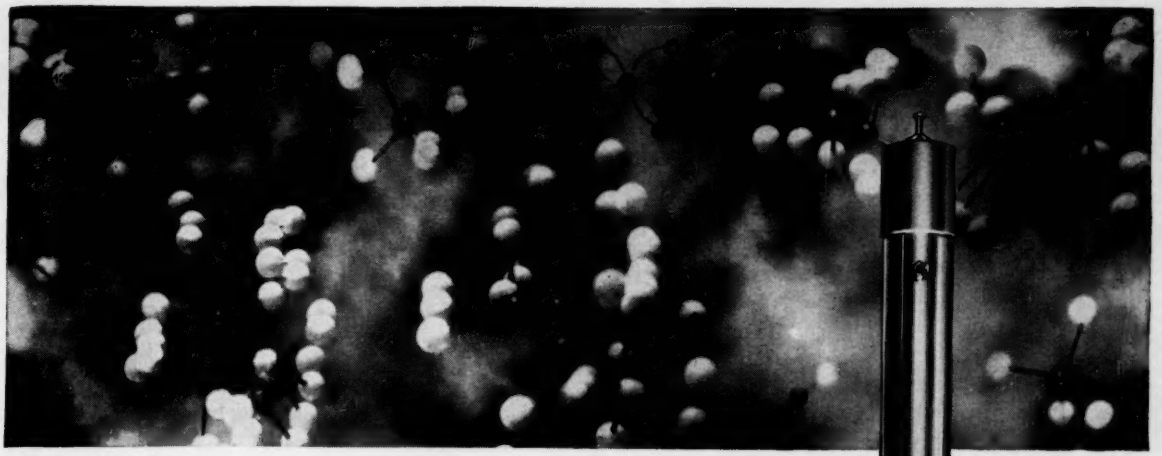
**NAME**_____

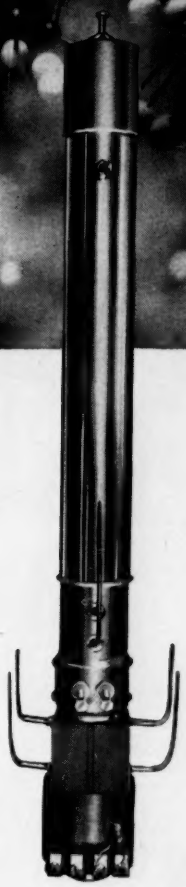
**POSITION**_____

**COMPANY**_____

**ADDRESS**_____

1

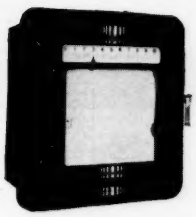




# Spotlight your gas compounds

## WITH AN L&N

## INFRARED GAS ANALYZER



• Ethylene purity—$SO_2$ loss—methane build-up—isobutane loss—each is a different gas measurement, in a different process, for different end products. But all are being measured successfully by L&N's Infrared Gas Analyzer, expressly designed for *plant analyses* of gas compounds in multi-component streams.

Typical of the Analyzer's application is measurement of $SO_2$ in $H_2SO_4$ stack gas, over the narrow range of 0 to 2% $SO_2$, with these results—

**Stability**—0.01% $SO_2$

**Sensitivity**—0.005% $SO_2$

**Readability**—0.005% $SO_2$
*(Reading taken at 0.2% $SO_2$)*

This highly precise measurement is possible because the Analyzer is engineered by L&N to meet the requirements of actual plant operation.

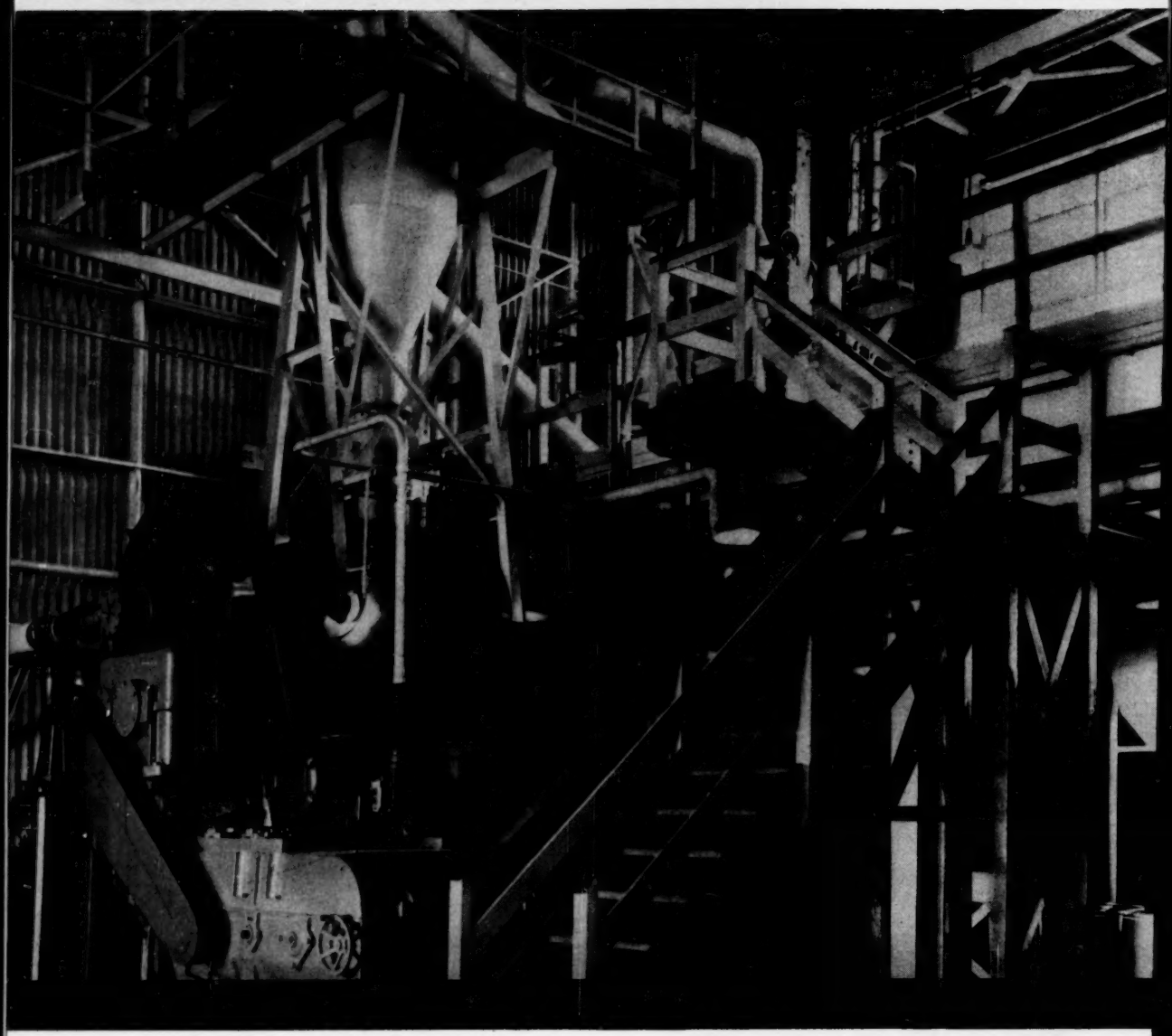
**IT'S ADAPTABLE**—You can mount the Analyzer almost anywhere and forget it. Nearby operating equipment—motor driven pumps, compressors, etc., can't affect the measurement either by introduction of stray electrical "hash" or through mechanical vibrations. Such immunities make the Analyzer a "natural" for plant use.

**IT'S SIMPLE**—The Analyzer has no moving parts—no lenses—no mirrors. It's the only single column gas analyzer built. These features make the Analyzer an uncomplicated, ideally practical addition to your process instrumentation.

The infrared specialists in our Application Investigations Lab will be glad to discuss your use of infrared analysis. You can take advantage of this service, without obligation, by answering the questions on our special Infrared Analysis Data Sheet 600-91-ND46(1) mailed on request.

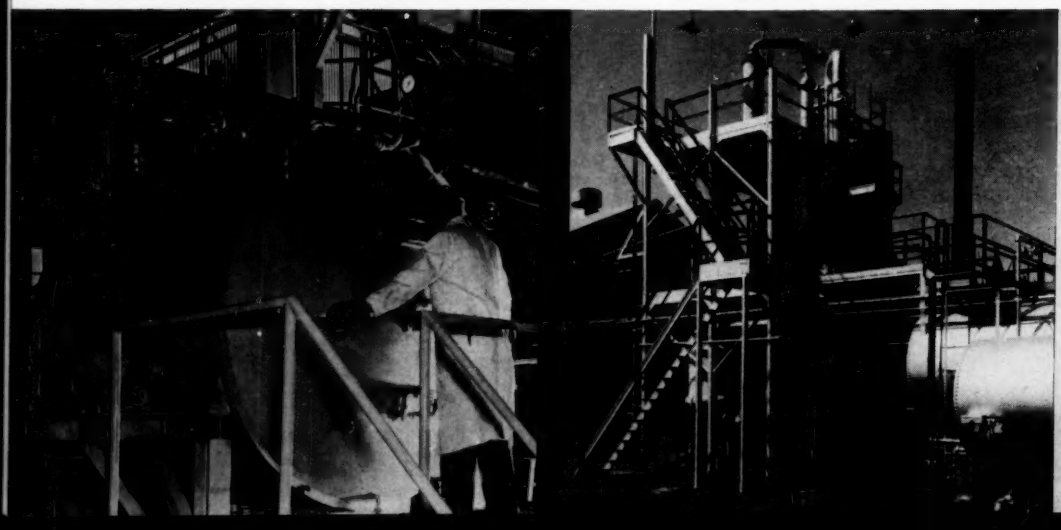
Or, you can learn more about the Infrared Analyzer and its Speedomax® recorder by requesting Demonstrator ND46-91(1), "How the L&N Infrared Gas Analyzer Works," from Leeds & Northrup Co., 4916 Stenton Ave., Phila. 44, Pa.

**LEEDS** *instruments* **NORTHRUP** *automatic controls • furnaces*



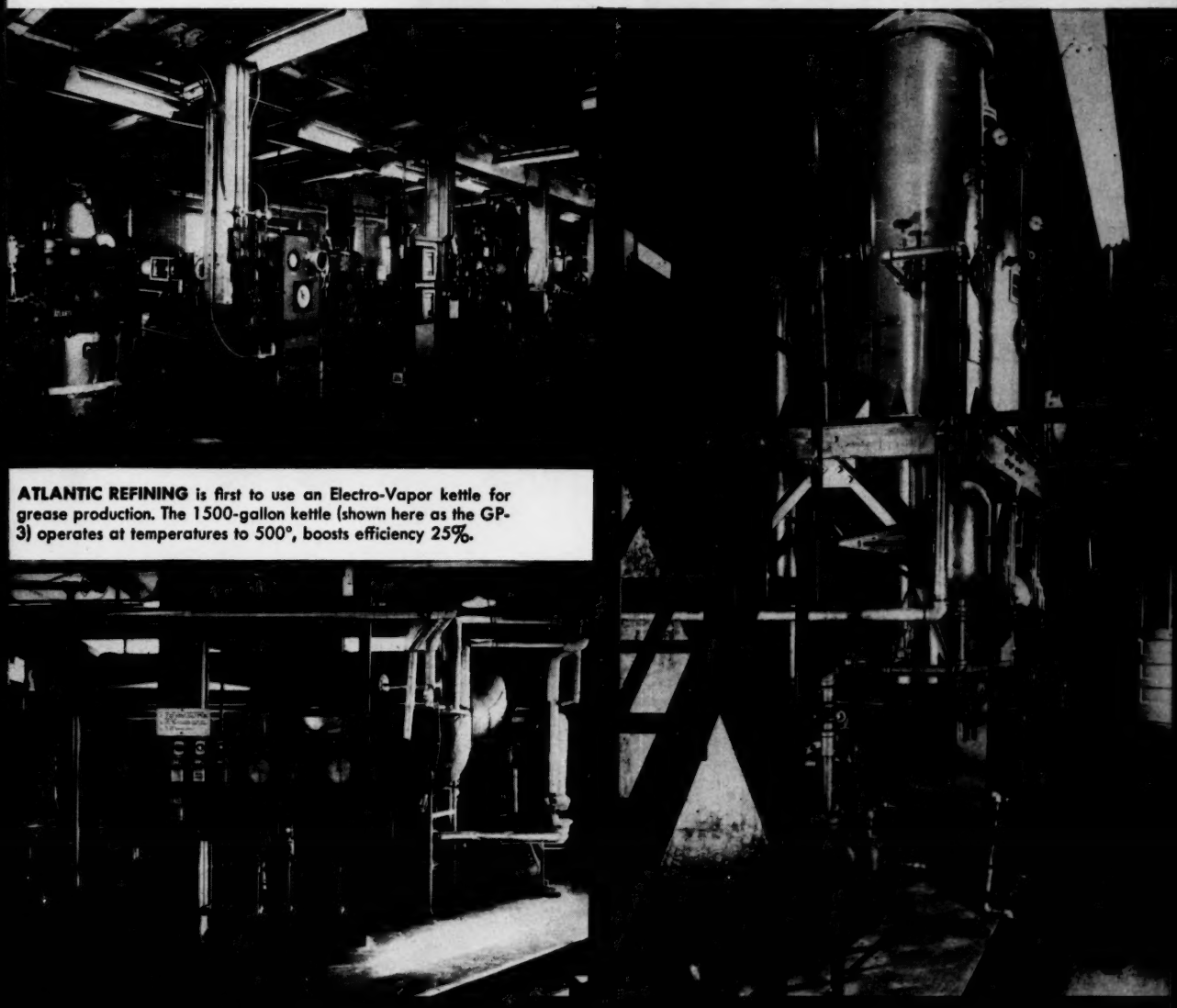
**CHAS. PFIZER & CO., INC.** uses a vacuum rotary dryer 30 ft. long and 5 ft. in diameter for Terramycin processing at their Groton, Conn., plant.

# Buflovak processing equipmen



Right:
**BARECO WAX CO**
**PANY,** Division of Petr
lite Corporation, uses tw
single effect, downflo
evaporators at Barnsdo
Okla. Shown here: t
235 sq. ft. evaporato

Left:
**PILOT PLANT** vacuu
double drum dryer is pa
of modern equipment d
veloped at the Buflov
customer service labor
tory — a complete
equipped produc
process research cent



**ATLANTIC REFINING** is first to use an Electro-Vapor kettle for grease production. The 1500-gallon kettle (shown here as the GP-3) operates at temperatures to 500°, boosts efficiency 25%.

**SEMET-SOLVAY** produces powdered polyethylene with a spray cooler. Part of a new technique, this cooling equipment boosts production ten times with little increase in required floor space.

**CHANNEL MASTER CORP.** recovers cyanide at their Ellenville, N.Y., plant. A double effect, forward flow evaporator processes waste water from a zinc plating operation.

# speeds chemical industry progress

Evaporation . . . Drying . . . Solvent Recovery . . . Crystallization . . . Extraction . . . Cooling—whatever your process, Buflovak equipment improves your operation, cuts your costs.

Because the Buflovak line is complete, Buflovak engineers can impartially recommend the equipment proven best for your job. Your own specification and the facts developed from special research provide sure guidance in selecting the right equipment for the job. For unusual problems Buflovak has the engineering and production facilities to build the most complex custom unit.

Sound research, expert engineering, on-schedule delivery, and continuing customer service combine to provide you with superior processing equipment, built to boost your profits. *Send for Catalog 386: "Buflovak Processing Equipment."*

**Conduct your research at the Buflovak Lab**

Many progressive chemical companies bring their basic problems to Buflovak. In a completely equipped laboratory they can test a few beakers of material, or run quantity lots on a pilot plant, production scale. Whatever the procedure, positive, practical methods are established. Over 7,500 practical answers have been found here. The Lab is at your service.

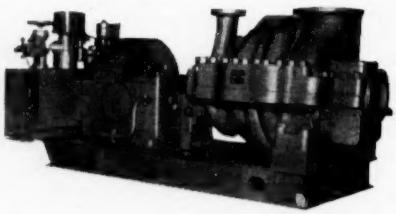
BLAW-KNOX

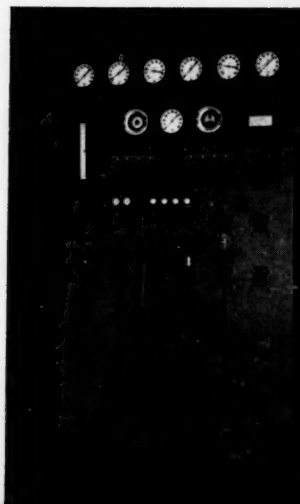
## BLAW-KNOX COMPANY

*Buflovak Equipment Division*
*1543 Fillmore Avenue, Buffalo 11, New York*

**Background**: *Compressing isobutane in refrigeration-system of alkylation plant of Petro-Tex Chemical Corp.* **Foreground**: *Cutaway of high-pressure seal of Cooper-Bessemer Type RD Centrifugal Compressor.*

**Matched to your needs . . .** *A wide range of types and sizes of Cooper-Bessemer Centrifugal Compressors are available to assure optimum performance on your processing or air supply application.*





**Undivided responsibility . . .** *We can engineer the entire compressor installation, including drive and controls. Cooper-Bessemer En-Tronic® Controls* provide any degree of automation.

John Fullemann, *Chief Turboproduct Design Engineer, right,*
*and* Kenneth Stevenson, *Turboproduct Designer,*
*The Cooper-Bessemer Corporation, discuss...*

# How reliable Cooper-Bessemer Centrifugal Compressors aid 'round-the-clock processing

For example, here's the picture at Petro-Tex Chemical Corp., Houston: The entire sulfuric acid alkylation plant banks on the dependable performance of the Cooper-Bessemer Type RD Centrifugal Compressor which handles isobutane for refrigeration. This unit operates on a continuous, 24-hour basis, handling 11,125 cfm and boosting pressure from 16.2 to 98 psia. Its constant availability is a must.

Of course, many things go into Cooper-Bessemer centrifugals to assure this kind of reliability. For example, take the two-sleeve oil film type seals shown in the illustration. This Cooper-Bessemer design is capable of sealing against pressures of more than 1000 psi, for utmost dependability in processing service.

Bear in mind, too, that the performance of Cooper-Bessemer equipment is backed by an unsurpassed service organization to help protect your plant investment and assure optimum operating economy. For further information, call our nearest office.

*BRANCH OFFICES:* Grove City • New York • Washington • Gloucester • Chicago Minneapolis • St. Louis • Kansas City • Tulsa • New Orleans • Shreveport • Houston Greggton • Dallas • Odessa • Pampa • Casper • Seattle • San Francisco • Los Angeles

*SUBSIDIARIES:* Cooper-Bessemer of Canada, Ltd.... Edmonton • Calgary Toronto • Halifax
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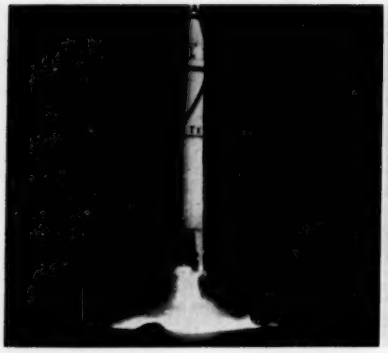
Cooper Bessemer

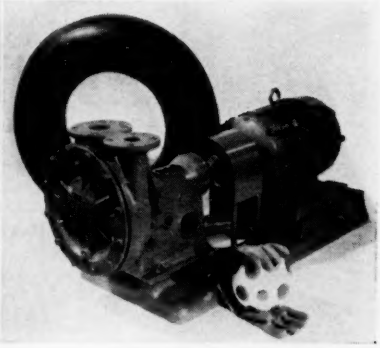
**GENERAL OFFICES: MOUNT VERNON, OHIO**

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

# PUMPAGE

**Goulds news about pumps for process industries**





## Rocket's red roar

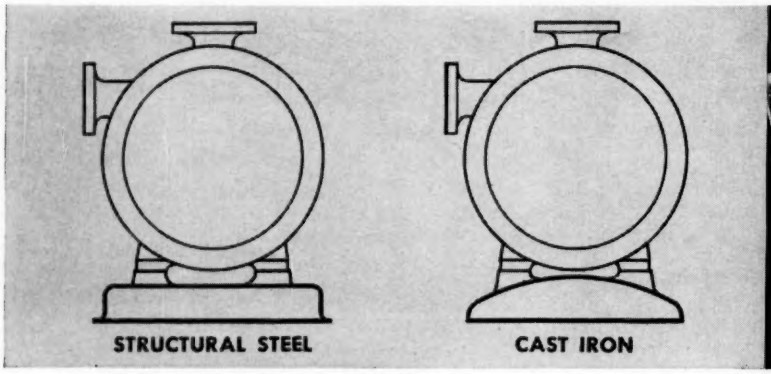
After the countdown—a roaring and soaring! The fuels that make rockets roar contain highly abrasive solids, ignite and burn rapidly with the slightest contact with air or oxygen. Handling them is a problem—pumping temperatures run as high as 550° F. For one government installation, Goulds developed a vertical process pump with an inert gas chamber that is used as a barrier between pumpage and rotating shaft seal. Gas pressure is maintained by an automatic purgerator slightly above suction inlet pressure to insure no contact between the mechanical seal and the abrasive solids. This pump has been found so broadly applicable that it is now a standard model in our line.

## Now . . . a centripetal pump!

A unique use of centripetal action lets Goulds Fig. 2520 handle liquid, air, or liquid *and* air! The centrifugal force of the impeller separates the liquid from the lighter air, which accumulates at the center of the impeller and casing. The liquid, circulating at the casing periphery, is directed (by centripetal action) toward the center, pushing the air ahead of it and through the discharge. Once primed, this pump *stays* primed! It can't air bind—even with loops or leaks in your suction line. Handles foaming solutions and emulsions easily. You can use it for almost anything: as a scavenger, for transfer work, for cleaning up, for pilot plant work. Ask for Bulletin 725.6 for all the details!

## Latex: Handle with Care

Before synthetic latex can become the bouncy consumer products you see here, it must be a fairly instable liquid, able to gel or coagulate easily. For that reason, a pump must handle latex gently or the impeller will clog and have to be cleaned frequently. Such a pump is the Goulds Fig. 3715—six of which are presently being used by a rubber manufacturer to transfer latex from storage tanks to tank cars and in the latex concentrator line. A semi-open impeller allows a minimum of mechanical shock or friction at optimum efficiency. Normal cleaning operations are performed easily, because the casing cover and impeller can be easily removed without disturbing pipe connections. Bulletin 725.4.



## Cast-iron bedplates

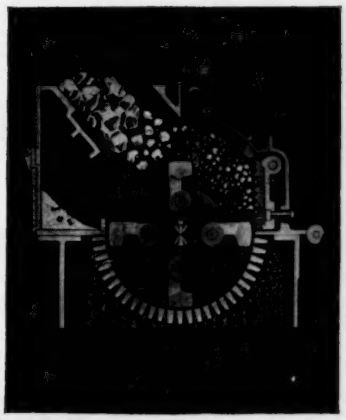
A rigid well-grouted bedplate under your pump and driver is the first requirement for trouble-free operation. Accordingly, Goulds furnishes rigid corrosion-resistant cast-iron bedplates as standard at no extra cost. The Goulds special camber top prevents accumulation of corrosive liquids. The camber design with its large accessible grout hole at the high point insures complete fill-up of bedplate cavity with grout. This economical design, jig-drilled for pump and motors, provides integral motor pad, eliminating costly separate motor base.

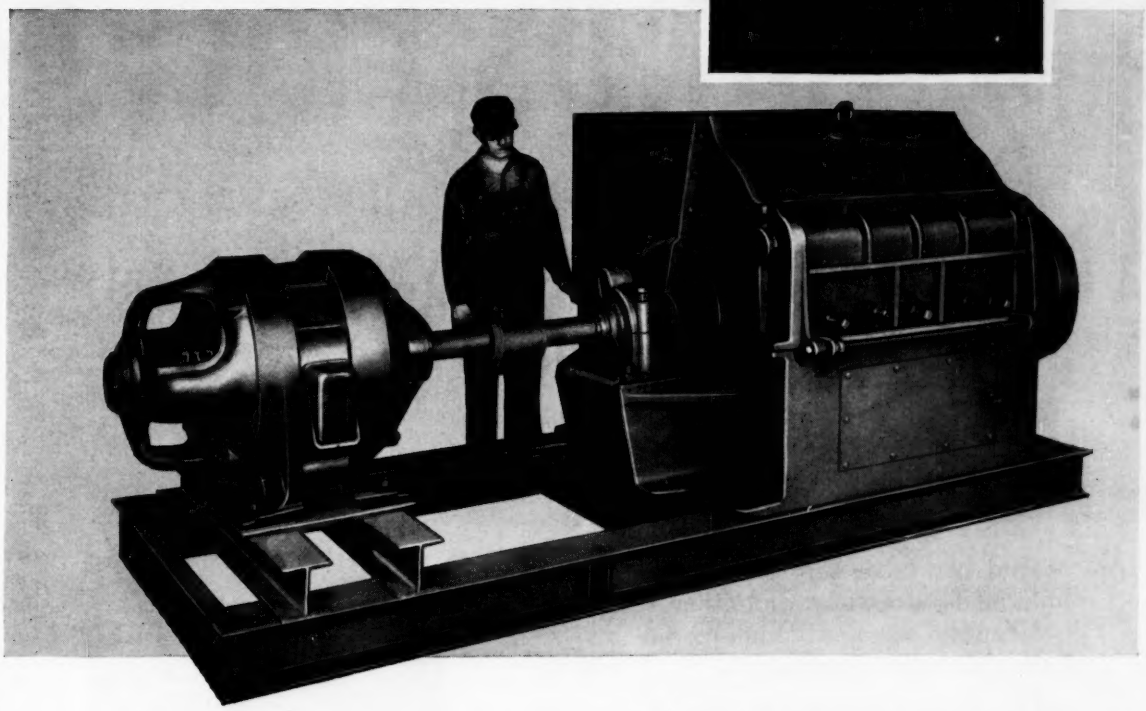
**GOULDS GP PUMPS**

## Get all the news monthly—FREE!

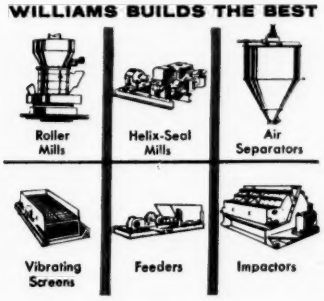
If you've liked reading about the new designs and applications of pumps as presented on PUMPAGE, then you'll appreciate getting a sister publication, GOULDS NEWS, mailed to you free every other month. GOULDS NEWS is a 4-page newsletter that highlights new developments in pumps and profitable ways that they are used. You can add your name to our mailing list by merely writing, on your letterhead, to Goulds Pumps, Inc., Dept. CE-89, Seneca Falls, N. Y.

# Complete size reduction... from start to finished product... in a single Williams Hammer Mill





## Cut costs as much as 50% on production... up to 75% on equipment




In all normal crushing operations, a Williams heavy duty hammer mill can take most material and, *in a single pass*, reduce it to finished size! Production economies alone, in labor, power, maintenance, as well as stepped up output of better quality and more uniform products, will *cut costs up to 50%*.

Savings in original installations, *as high as 75%*, can also be expected. By making primary and secondary crushers unnecessary, a Williams hammer mill will eliminate all extra conveyors, drives, other equipment, special foundations and additional housing.

Williams hammer mills are built for daily rough and rugged service. Extra heavy manganese steel liners and breaker plates, oversize shafts, massive parts and reinforcements, all defy shock and wear, reduce downtime and replacements to nil.

If the cost price squeeze is one of your problems, get the facts about Williams hammer mills. *Write now for catalog.*

**WILLIAMS**
CRUSHERS GRINDERS SHREDDERS

*Oldest and Largest Manufacturers of Hammer Mills in the World*

**PATENT CRUSHER & PULVERIZER CO.**
2706 N. 9th St. St. Louis 6, Mo.

# PROTECTION PLUS at a MINUS PRICE!

## Corrosion Resistance reatly Increased with DeZURIK PLASTIC-COATED VALVES at Only a Slight Increase in Price!

Mild corrosive services—such as alkalies, mild acids, sea water and other neutral salts —formerly required high-priced alloys in valves to resist corrosion.

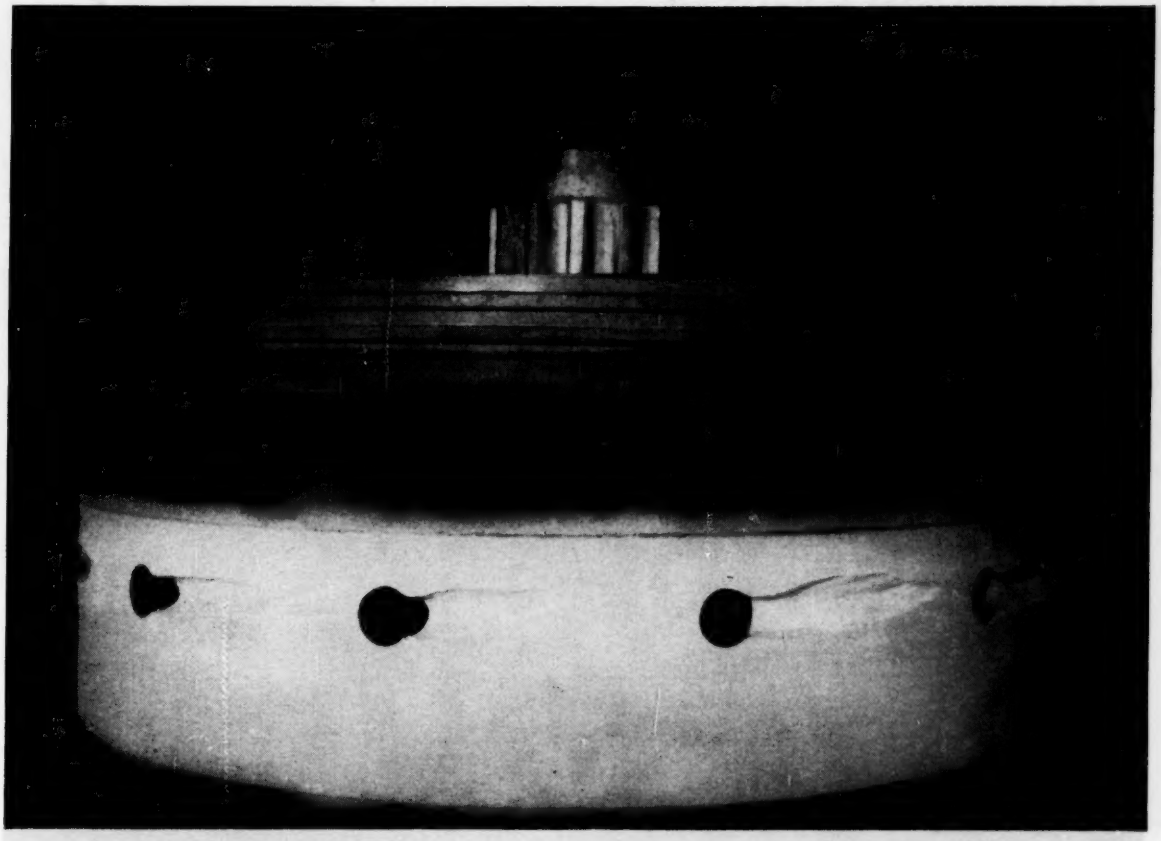
Now, these and other similar services can be handled by a DeZurik Plastic-Coated Valve at a price only slightly higher than a cast iron valve.

The plastic coating of DeZurik Valves resists attack from mildly corrosive services and is particularly suited to the handling of de-ionized and de-mineralized water where iron contamination is objectionable.

Plastic-Coated DeZurik Valves eliminate the frequent replacement of low cost valves on systems where contamination or corrosion destroyed the valve in a short time, yet the use of more expensive high alloys was prohibitive. Now **one** valve, costing only slightly more than a cast iron valve, eliminates replacement valve costs, maintenance expense and down time!

Get more information from the DeZurik representative in your area, or write to Dept. P. C.

DeZURIK CORPORATION
SARTELL, MINNESOTA.



The Georgia Kaolin Company, well-known manufacturer of industrial clays, reports that they have made substantial savings by coating worn separator centrifuge bowls with Norton ROKIDE "A" coating. Worn bowls were previously returned to their manufacturer after six to eight months of high speed service for restoring to their original condition. But now Georgia Kaolin applies ROKIDE "A" coating before the bowls become badly worn . . . and at a fraction of repair cost at the factory. Service life is greatly extended. Maintenance costs and down time are substantially reduced.

# How ROKIDE* Coatings increase service life, cut maintenance costs of moving parts

ROKIDE coatings are applied by heating the end of a ceramic rod and projecting the molten particles at high velocity. Reaching a prepared surface, they adhere and solidify. Protecting parts of a wide variety of sizes and shapes, these coatings are in extensive, rapidly increasing use in military and general industrial applications.

Three types of ROKIDE spray coatings — "A" aluminum oxide, "ZS" zirconium silicate and "Z" zirconium oxide — are hard, adherent, crystalline refractory materials. Parts, particularly metals, on which these coatings are especially useful are those requiring thermal or electrical insulation . . . resistance to wear or corrosion . . . excellent mechanical strength . . . dimensional stability . . . relative chemical inertness.

*Possible applications: bearing surfaces, metal rolls, feed rolls, nozzles, pump shafts, thermocouple tubes and wire, mechanical seals, extrusion dies, laboratory molybdenum boats, vibratory feed hoppers, metal guides, metal melting pots, sanding fixtures, induction heating coils, strain gages, and applications in the wire industry.*

Norton maintains facilities for applying ROKIDE coatings at Worcester, Mass., and at its plant 2555 Lafayette Street, Santa Clara, California. For further facts, write to NORTON COMPANY, New Products Department, 507 New Bond Street, Worcester 6, Massachusetts.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON
NEW PRODUCTS

Making better products . . . to make your products better

**NORTON PRODUCTS** Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — **BEHR-MANNING DIVISION** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

# HANDLING "PROBLEM" FLUIDS OR GASES?

## Specify ALUMINUM GATE VALVES by Darling

*Aluminum flanged end gate valve. Also available with other types of ends. Can be furnished with inside screw stationary stem.*

Where you're handling highly corrosive materials... or where valve weight is a factor... Darling Aluminum Gate Valves make sound economic sense.

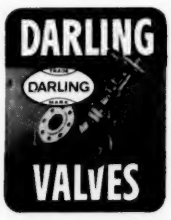
**High-corrosion-resistant aluminum alloys**... carefully selected and thoroughly tested by Darling metallurgical engineers... are used for structural and pressure-containing parts. They've been *proved-in-use* as the most generally corrosive-resistant aluminum alloys in use today.

**Double disc parallel seat principle** assures maximum life under the most exacting service conditions. "No pocket" discs and wedges prevent accumulation of line scale or sludge. Wedge design reduces friction to a minimum, assures positive sealing and ease of operation.

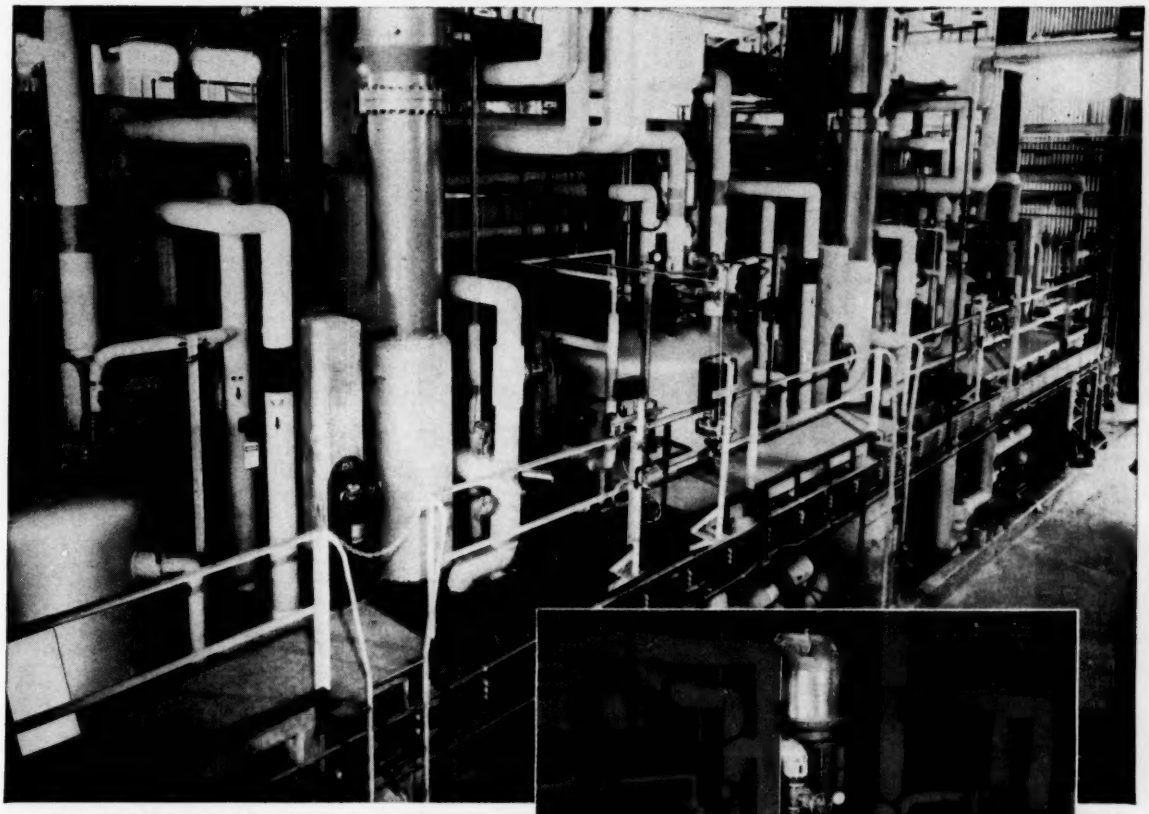
**DARLING VALVE & MANUFACTURING CO.**

Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



# FIRST LARGE-SCALE HIGH-ENERGY LIQUID FUEL PLANT USES COWLES DISSOLVERS



*(Above) Portion of $38,000,000 plant being operated by Callery Chemical Company for the Navy, showing typical Cowles Dissolver installations.*

*(Right) One of six giant Cowles Dissolvers installed by Callery Chemical Company in new Muskogee, Oklahoma, HiCal® plant.*

Because Cowles Dissolvers provided the best pattern of dispersing materials and compounds to fine particle size in the shortest possible time, Callery Chemical Company selected six of the largest Cowles Dissolver models for this great new plant. Basic in efficiently processing the highly critical materials involved is the patented Cowles Impeller with its unique power transmission system.

Close cooperation between engineers of Callery, The Ralph M. Parsons Company and Morehouse-Cowles, led from a two-stage operation to a single-step method combining the dispersion and reaction stages.

If your product requires ultimate dispersion, dissolving, emulsifying or deagglomeration, a Cowles Dissolver will do it better, faster, in less space, at less cost.

***Let us prove it in your plant at our risk . . .***

Write us today about your problem. Our applications engineers are at your service to help you solve it!

MOREHOUSE-COWLES, INC.
1150 San Fernando Road, Los Angeles 65, Calif.

*Representatives in principal cities*
*Convenient lease and time-payment plans.*

**Steam trap dependability is a matter of what the manufacturer puts into the trap**

# ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

**1. Efficient, proved operating principle**

Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

**2. Good design**

Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

**3. Highest quality materials of construction**

Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

**4. Good workmanship**

Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

**5. Application know-how**

Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.

860 Series for low pressure heating service.

800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

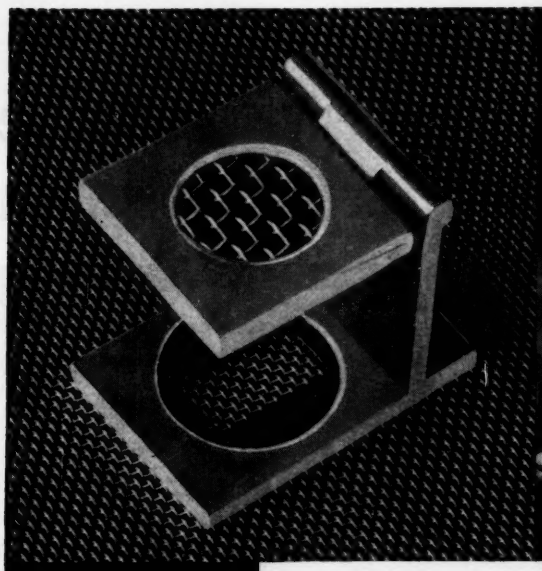
200 Series, bottom inlet, top outlet.

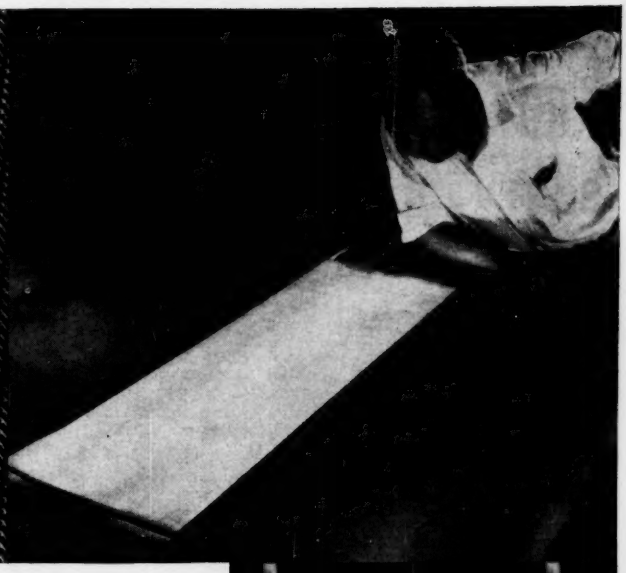
Forged Steel Series for high pressures, high temperatures.

The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

**ARMSTRONG MACHINE WORKS**

**8589 Maple Street Three Rivers, Michigan**





# Who counts 'em?

*CAMBRIDGE does . . .*

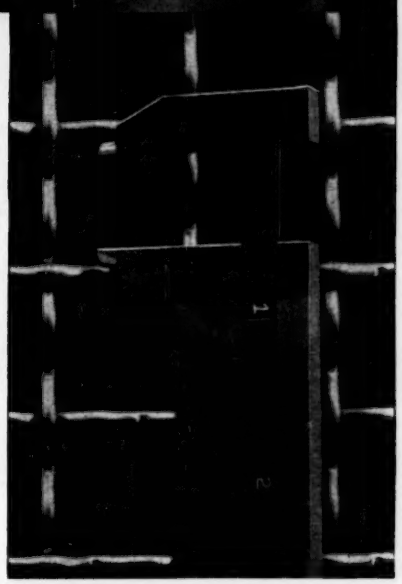
. . . because *exact* mesh count and mesh size are the trademarks of Cambridge INDUSTRIAL WIRE CLOTH.

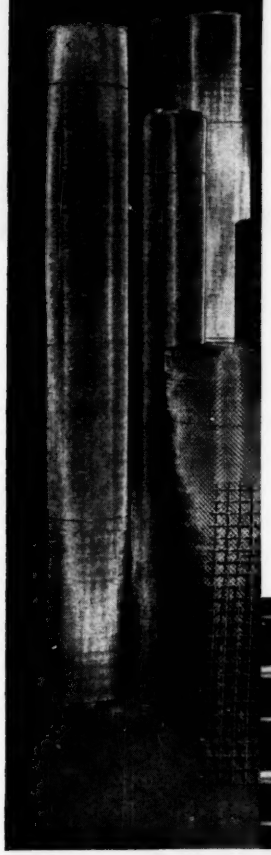
But, quality isn't the whole story. When you call Cambridge for industrial wire cloth, you also get service . . . prompt answers to your inquiries . . . quicker deliveries . . . and an experienced Field Representative who follows up your order to make sure our product is giving you the best possible service. Let us quote on your wire cloth needs. We manufacture wire cloth from any metal or alloy—including titanium—in nine basic weaves. Very likely, we have what you require in our warehouse right now. For samples or more information, call your Cambridge Field Engineer...he's listed in the yellow pages under "Wire Cloth". Or, write for FREE 94-PAGE CATALOG.

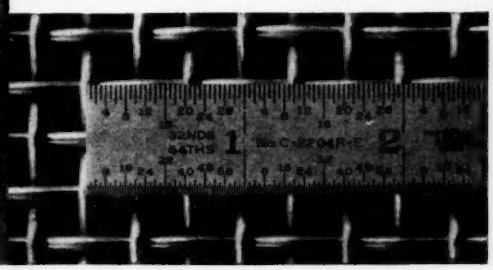
**The Cambridge Wire Cloth Co.**

Department G • Cambridge 8, Md.

*Manufacturers of Wire Cloth, Metal-Mesh Conveyor Belts, Wire Cloth Fabrications*

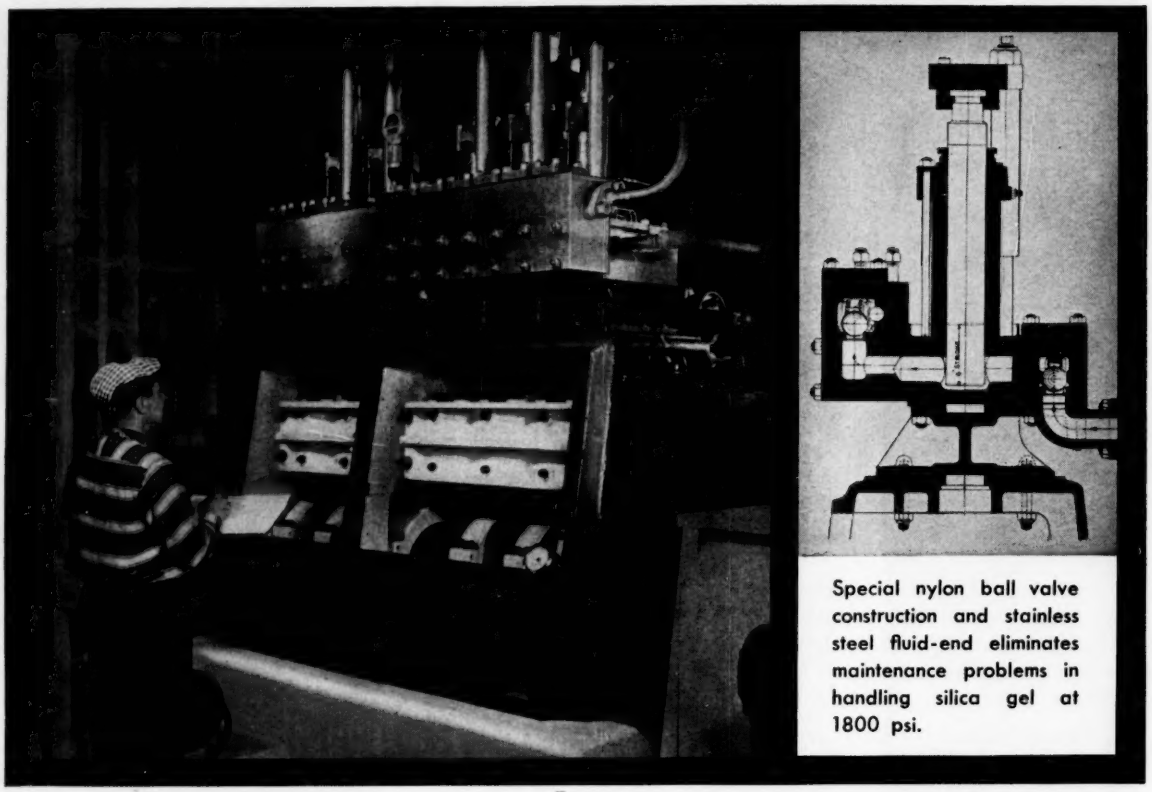






AT DAVISON CHEMICAL LTD.

# Aldrich pumps tame highly abrasive, corrosive slurry in high pressure spray drying operation





Special nylon ball valve construction and stainless steel fluid-end eliminates maintenance problems in handling silica gel at 1800 psi.

When Davison Chemical Ltd. built its new plant in Valleyfield, Quebec, for the production of petroleum catalysts, a major problem was to find a pump that (1) had the abrasion and corrosion resistance to stand up in a continuous high pressure process without downtime or excessive maintenance and (2) could maintain the steady pumping pressures necessary to control particle size, density and porosity of the spray dried product.

**What was done:** Davison Chemical engineers called on Aldrich for help and the result was the special valve design shown. After two years of continuous operation, the Aldrich pumps continue to deliver constant pressure without major overhaul. The General Manager of the plant reports: "We are quite pleased with the performance of these pumps."

**How Aldrich can help you:** Solving special pumping problems for the chemical industry is the most important work we do. We would welcome the opportunity to discuss your specific problems . . . no matter what the liquid or slurry, or how high the pressures. Standard Aldrich Pumps range from 25 to 2500 hp. Pressures to 30,000 psi. See our insert in Chemical Engineering Catalog for condensed data. Aldrich Pump Company, 3 Gordon Street, Allentown, Pennsylvania.

***the toughest pumping problems go to*** ALDRICH

# When your new plant goes "on stream"...

## ...benefit from the proven advantages of a PITTSBURGH GRANULAR ACTIVATED CARBON Adsorption System!

Are you planning new processing facilities for liquid or vapor phase adsorption? If so, you should be acquainted with the unique and *proven* advantages of a continuous column system using PITTSBURGH Granular Activated Carbons.

Here are just a few typical applications where such a unit operation can improve efficiency and reduce costs:

**1. Incoming Materials:** Removal of impurities from process water, gases and other raw materials.

**2. Materials in Process:** Purification or decolorization of prime products. Purification or recovery of valuable solvents used repeatedly in recirculating streams. Catalysis and catalytic support.

**3. Plant Effluents:** Treatment of waste gases and liquids to recover valuable constituents or to eliminate pollution problems.

If you're planning new or improved adsorption facilities at your plant, it will pay you to talk to a PITTSBURGH Technical Representative. He has helpful engineering data and case history studies which demonstrate how you can benefit by the use of PITTSBURGH Granular Carbons in a continuous column system.

**Want More Information? Send for This Booklet**

Describes various types of liquid and vapor phase adsorption operations . . . and types of Pittsburgh Granular Carbons best suited for each one. Send for your free copy. Write to Dept. P.

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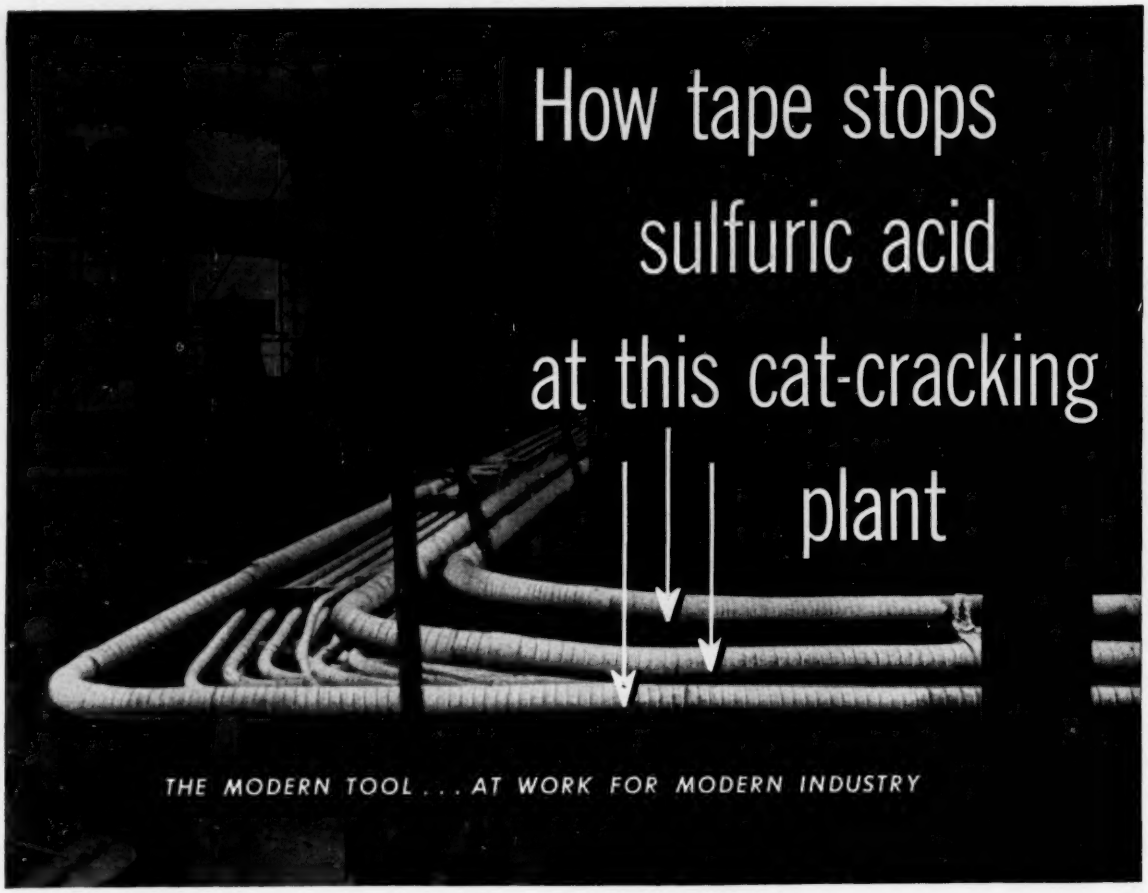
ACTIVATED CARBON • COAL CHEMICALS • PLASTICIZERS • PROTECTIVE COATINGS • PIG IRON • COKE • FERROMANGANESE • CEMENT




## FIVE YEARS UNDER THESE HIGHLY CORROSIVE CONDITIONS PROVES THAT POLYKEN PROTECTION WORKS . . . *TO TRIM COSTS*

Look in on one of the world's largest fluid catalytic cracking units. A maze of conduit and pipe exposed to an extremely corrosive sulfuric acid atmosphere.

Formerly, these structures had to be painted every three or four months. Maintenance costs were excessive. Then, five years ago, they were wrapped with Polyken Protective Tape Coating. They have needed practically no attention since.

### INERT POLYETHYLENE

The reason is that Polyken takes amazingly inert polyethylene and makes it into a tape coating with all these properties.

- **tough and elastic**
- **unplasticized, non-drying film**
- **doubly thick adhesive to seal all voids**
- **far higher adhesion for a true bond to pipe surface**
- **lower water vapor transmission rate**
- **higher electrical insulation resistance**
- **better cold weather handling and durability**

Check the savings. Contact the Polyken distributor in your area.

**Atlanta, Georgia:** Steele & Associates, Inc.
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**Polyken®**
**Experienced in modern PROTECTIVE COATING**
THE KENDALL COMPANY
Polyken Sales Division

DEVELOPMENTS . . .

AUGUST 24, 1959

# Chementator

C. H. CHILTON

**A new glass flake-polyester coating is easier to spray onto tanks and pipes than coating systems using chopped glass roving. It's under development by Owens-Corning at Ashton, R. I., laboratories.**

**Wyoming trona deposits are getting increased attention from prospective soda ash producers. Now on the scene are Stauffer Chemical and an unidentified Texas syndicate.**

**General-purpose plant for reprocessing spent nuclear fuels will be built at GE's Hanford Works. Vitro expects to land contract for engineering of $6-million project. Plant will handle fuel elements of all types.**

## How to add salt to the ocean

Electrodialysis of sea water gets a reverse twist this month as Ionics, Inc., Cambridge, Mass., ships to Japan a pilot unit for *boosting* the salt content of sea water.

With no native salt deposits, Japan is dependent on the sea or on imports for its salt supplies. The country imports about 2 million tons of salt annually. The commodity is under strict government control.

The new unit is designed to produce a concentrated brine stream carrying 1 ton/day of salt. It will be operated by Asahi Electro-Chemical Co., a government-approved licensee under Ionics' Japanese patents. Another Japanese firm, New Japan Chemical Co., has announced its intention of producing 50,000-60,000 tons/yr. of salt via this route, pending government okay. The latter company hopes to reduce costs to around half their present level, a goal which Ionics considers attainable.

A sea-water concentration unit differs little in construction from an electrodialysis unit designed to convert salt water into fresh. The latter discharges a large waste stream, slightly enriched in salt content, while turning out a smaller primary stream of fresh water. In the new unit the primary product will be greatly enriched in salt content (15-25%), while the much larger waste stream will be only slightly depleted in salinity.

Can the same unit serve a dual function, producing both concentrated brine and fresh water? It's possible, says Ionics, but not economically practical.

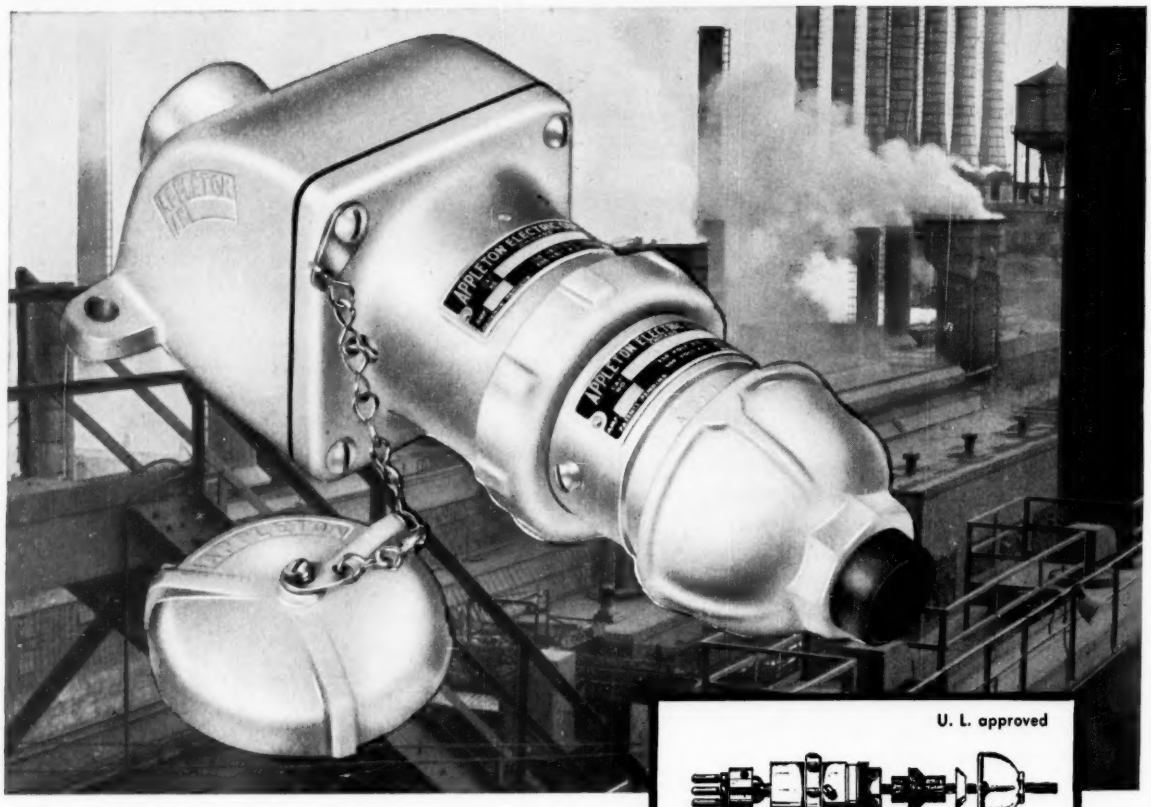
## Tire makers back new synthetic cords

Two new tire cord materials have won hard-to-come-by seals of approval from tire makers in recent weeks:

• Firestone emphatically announced test results that show tire cords of Dacron (or Terylene) polyester fiber equal or superior to any tire cords in commercial use today.

# APPLETON® "AE" SERIES

## Plugs, Receptacles and Receptacle Fittings



U. L. approved

### Versatile, Precision Manufactured Plugs and Receptacles for Hundreds of Industrial Applications

The simple, sturdy construction of these APPLETON "AE" Series Plugs, Receptacles and Receptacle Fittings is your assurance of lasting, heavy-duty service.

Complete terminal units, equipped with solderless connectors enable connections to be made quickly with a minimum of effort. APPLETON "AE" Series Receptacle Housings are available in four styles to meet your specific requirements: Lift Cover Housing . . . Plain Housing . . . Threaded Housing . . . and Cap Housing. The Lift Cover Housing has a rubber-gasketed cover mounted on a self-aligning plate to form a dust-resisting enclosure which excludes chips, shavings, etc. Plugs are available with and without Clamping Ring. For utmost versatility and service life, APPLETON "AE" Series Plugs, Receptacles and Receptacle Housings offer an outstanding combination of quality features and economy of purchase.

*Sold through franchised distributors only*

APPLETON ELECTRIC COMPANY
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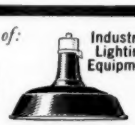
*Also Manufacturers of:*

"ST" Series Connectors



Industrial Lighting Equipment

Malleable Iron Unilets

Automatic Reelites

Fleets are now being equipped with the new tires for further tests in actual use.

• In Japan, Otsu Rubber Co., Osaka, announced plans for fall marketing of vinylon-cord tires. Company says the polyvinyl alcohol fiber makes tires twice as durable and less affected by water than rayon cord, less extensible and more heat-resistant than nylon cord.

Firestone's statement noted company's years of testing new synthetic fibers for tire cords. Acrylics were eliminated early in the game. After completing a million test miles on polyester-cord tires, however, Firestone finds they give increased mileage, improved ride, do not "flat spot" (a drawback sometimes attributed to nylon cord).

Vinylon is made by Kurashiki Rayon Co. Air Reduction has acquired U.S. rights to Kurashiki's vinylon process and is test-marketing staple and tow imported from Japan.

Tests made by one large rubber company show that in elongation and tensile strength vinylon cord is lower than nylon, higher than rayon; its flex life at elevated temperature, shorter than rayon's or nylon's, must be improved.

Other major rubber companies are actively interested in polyester and PVA cords, as well as in glass fibers and steel cable (the latter is already used here for truck tires, in Europe for passenger tires). One, while sharing Firestone's view that good tires can be made with polyester fiber, cites high price and temperature sensitivity as drawbacks.

## Terephthalic acid gets new producers

Oronite Chemical Co. has joined the small but growing ranks of terephthalic acid producers by converting its isophthalic acid plant at Richmond, Calif., to double duty.

Although the company purposely designed the Richmond plant to allow such versatility, Oronite's recent terephthalic run represented first full-scale output of this chemical from a unit that's been turning out isophthalic for three years. Conversion requires minor adjustments in final purification steps in addition to a switch in feed from meta-xylene to para-xylene.

Oronite's TA production is headed for Japan, where demand has already outstripped capacity of Mitsui's new Scientific Design-engineered plant. Mitsui is now doubling its capacity.

Other U.S. producers of terephthalic acid (or its dimethyl derivative) include Du Pont, Hercules and Amoco. The latter's plant at Joliet, Ill., has run into startup difficulties but, *CE* has learned, is turning out products in commercial quantities, using the Scientific Design process for oxidizing mixed xylenes.

Another company may be getting ready for a plunge into terephthalic. Cowles Chemical Co., Cleveland, has piloted its modification of a process based on know-how bought from Europe. A Cowles spokesman hints that there will be a decision within the next three months. The company already operates an oxidation process for producing a line of benzoic and toluic acid derivatives.

## Fast reactions unlock wood chemicals

First commercial production of plastics from wood begins this summer. Products will be general-purpose molding compounds and thermosetting resins; feed will be waste wood. Producer is a large eastern company whose identity has not yet been revealed.

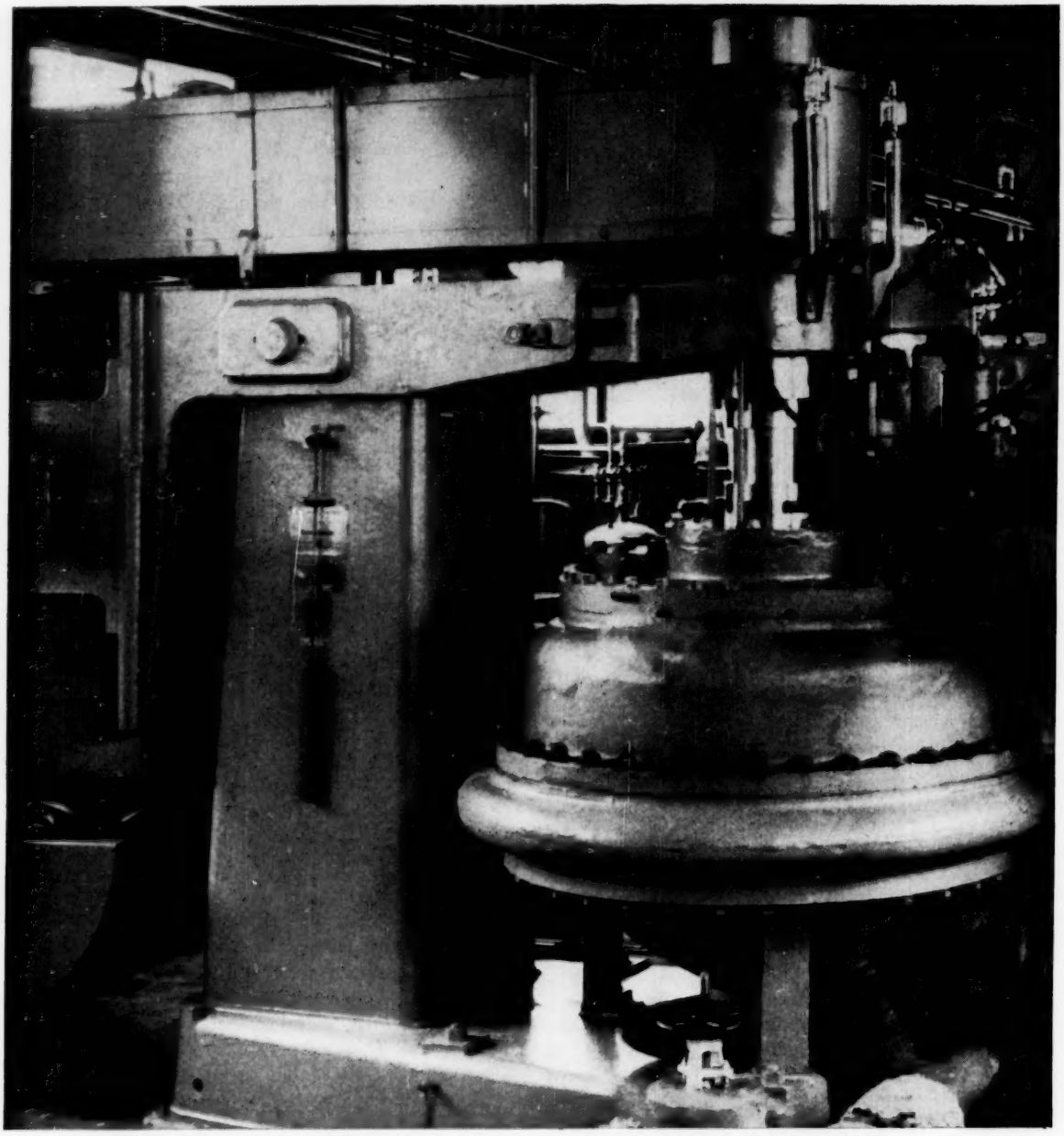
Process is one of a string of related developments resulting from eight years' work aimed at winning products of large-scale industrial utility from the entire wood substance. Six patents covering these developments have issued in recent months to Francis H. Snyder, New Milford, Conn.

Snyder's general approach is to release selected components of wood substance by fast reactions at high temperatures, isolating the desired product instantly before it has a chance to undergo secondary or degradative reactions with other substances. Temperatures are over 300 C., times are measured in seconds. Basic products are reactive lignin depolymerizates, cellulose fiber, soluble carbohydrates, furfural and other furan derivatives, plus considerable acetic acid (100-120 lb./ton hardwood waste) and smaller amounts of acetone, methanol, etc.

One of Snyder's processes can be used to produce hardwood chemical pulps; this process produces pulps of the same quality and in the same yields as from kraft or sulfite pulping, says Snyder. Costs are claimed to be much lower, and process can feed on most species of hardwood, can tolerate bark and decayed wood, is independent of size and shape of chips.

**(Continued on page 58)**

# MORE PRODUCTION OF HIGH



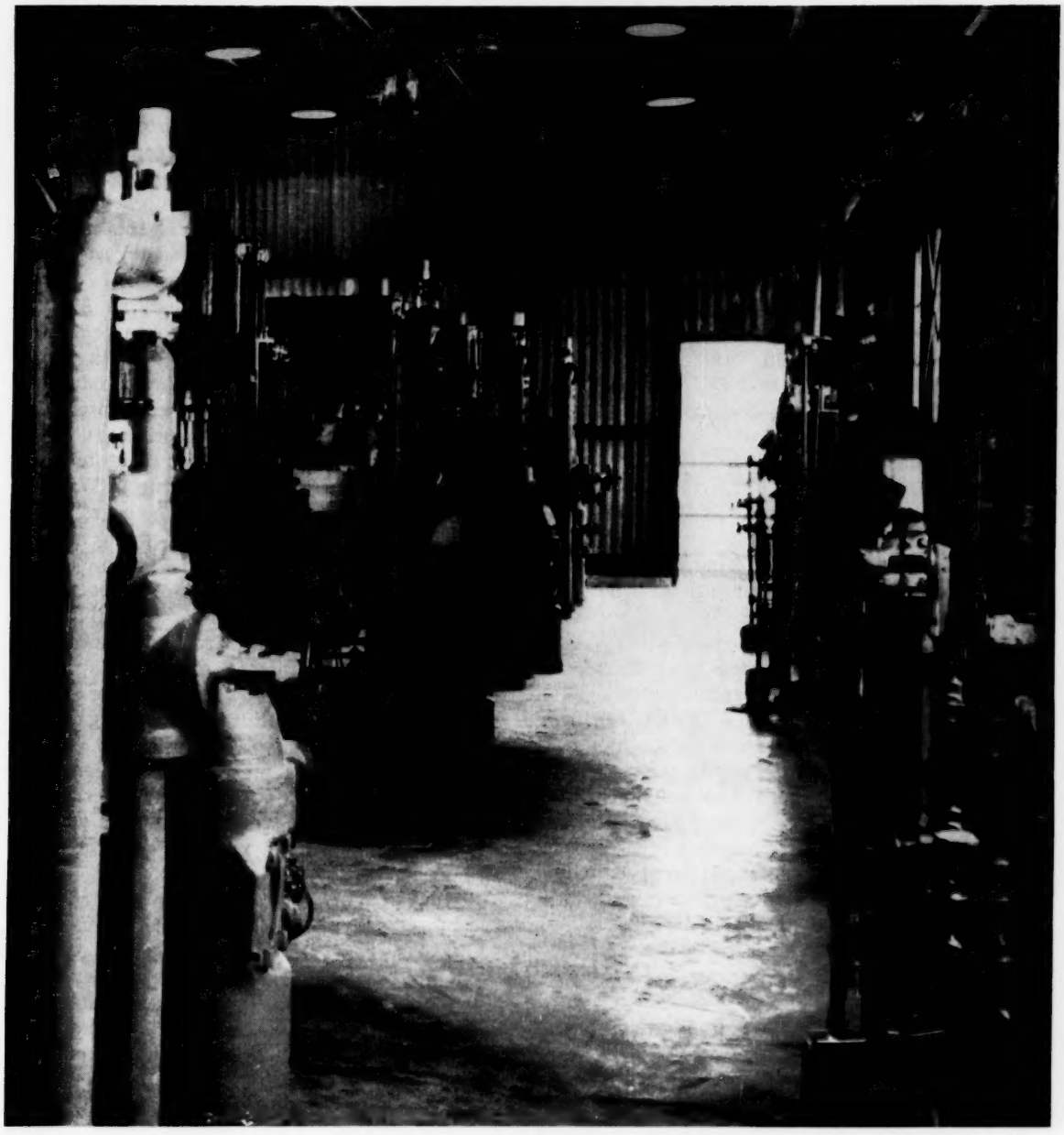
# MERCO PRESSURE CENTRIFUGES

*operate 24 hours a day . . . 7 days a week . . . at W. R. Grace's Polymer Chemicals Division*

**Large-scale production is provided in the plant of the W. R. Grace Polymer Chemicals Division to answer the growing demand for high-density linear polyethylene. The product is marketed under the trade name of GREX and is manufactured under license by the Phillips process.**

**For the catalyst removal step, Merco Pressure Centrifuges insure high quality product and continuous operation. The polyethylene polymer solution containing catalyst is fed through Merco Rotary Strainers to Merco Pressure Centrifuges which operate 24 hours daily, 7 days a week at superatmospheric pressures and temperatures. Each centrifuge can deliver an effluent product of *less than 8 ppm***

# DENSITY POLYETHYLENE!



impurity. Two-staging of the polymer-catalyst separation results in very high polymer recovery.

Merco Continuous Pressure Centrifuges and Strainers are the *only* units of their type continuously effecting a polyethylene-solid catalyst separation. The Merco Pressure Centrifuge has revolutionized many operations in the processing industries, where continuous efficient, high speed, controlled separation is required. Types are available to suit a wide variety of applications. For information, write Dorr-Oliver Incorporated, Stamford, Connecticut.

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Another process produces reactive lignophenols, furan aldehydes and acetic acid as major products. Furfural is obtained in yields comparable with that from corn cobs and oat hulls, according to Snyder.

Initial work on these processes was done at Arthur D. Little, Inc., under Synder's direction. Snyder has since removed the project to his own laboratories and pilot plant at New Milford and Brookfield, Conn.

## Stronger acid cuts fertilizer costs

Low-cost substitute for furnace and superphosphoric acids in liquid fertilizers is objective of a new Tennessee Valley Authority pilot plant at Wilson Dam, Ala. Idea is to concentrate cheap wet-process phosphoric acid by modified submerged-combustion evaporation up to about 68% $P_2O_5$, converting some 10% of its orthophosphoric acid to more desirable non-ortho forms.

Until now, sludge-forming traits have barred ordinary (54%) wet-process acid from use in liquid fertilizers. Formulators have had to use more costly furnace acid. As an alternative, TVA has been pushing use of minor proportions of superphosphoric acid, a highly concentrated (76% $P_2O_5$) form of furnace acid, which acts as a sludge-inhibiting sequestrant by virtue of its high content (about 50%) of pyro and polyphosphates (*Chementator*, Oct. 1957, p. 137).

TVA's new goal is complete independence of furnace acid for the liquid fertilizer industry. Wet-process acid concentrated to 68% $P_2O_5$ can be formulated into liquid fertilizer of high nutrient value without salting out. But concentration costs must be sufficiently low to end up with an over-all economic gain. Hence the need for thorough pilot-plant study of the concentration step, with its engineering problems of handling hot (550 F.) corrosive and toxic materials.

In another development, TVA is touting KOH for a hitherto out-of-bounds market for liquid fertilizer mixtures.

To safeguard burning qualities of their product, tobacco growers avoid fertilizers having any appreciable chloride content. Thus they can't use regular liquid formulations containing KCl, must stick with solid mixes containing the relatively insoluble $K_2SO_4$.

By using highly soluble KOH, formulators can now offer tobacco growers complete liquid fertilizers. TVA feels that higher concentrations and ease of use will more than offset added costs of KOH.

## Road tax handicaps chemical feedstock

Louisiana Congressman Overton Brooks is drafting a bill that would exempt from federal motor fuels tax all natural gasoline used as a petrochemical feedstock. Rep. Brooks expects to get backing for this measure from the natural gasoline industry as well as from petrochemical producers.

An attempt by Natural Gasoline Assn. of America to obtain relief via executive decision has met with little success. In a test case, R. A. Worley, an independent producer of Shreveport, La., petitioned Internal Revenue Service for an appropriate ruling. So far IRS has not acted on this request.

Unofficial government thinking in Washington is that such a request can be granted only by Congressional action redefining natural gasoline in the 1954 tax code.

Because of steadily increasing octane requirements, natural gasoline is beginning to lose its established position as a motor fuel component. Producers are eager to tap the lush petrochemical market, can offer this liquid hydrocarbon mixture as a cracking feedstock at 4.0-4.5¢/gal. (see *Chem. Eng.*, Jan. 12, 1959, pp. 76-78). But unless the chemical processor produces his own natural gasoline, he must pay a 2¢/gal. tax (3¢ gross, of which 1¢ is returnable as a "non-highway use" refund).

This situation thus favors integrated oil-chemical companies and puts independents at a disadvantage. Magnolia Petroleum Co., for example, as a natural gasoline producer can afford to feed natural gasoline to its big new ethylene plant now being built at Beaumont, Tex. The proposed legislation would eliminate such inequities.

## Tomorrow's Technology

Today's embryonic developments which have special significance for chemical engineers

### Graft polymers made on roll mill

Although radiation catalysis has more sex appeal, ordinary brute force may be the best way to make some graft polymers.

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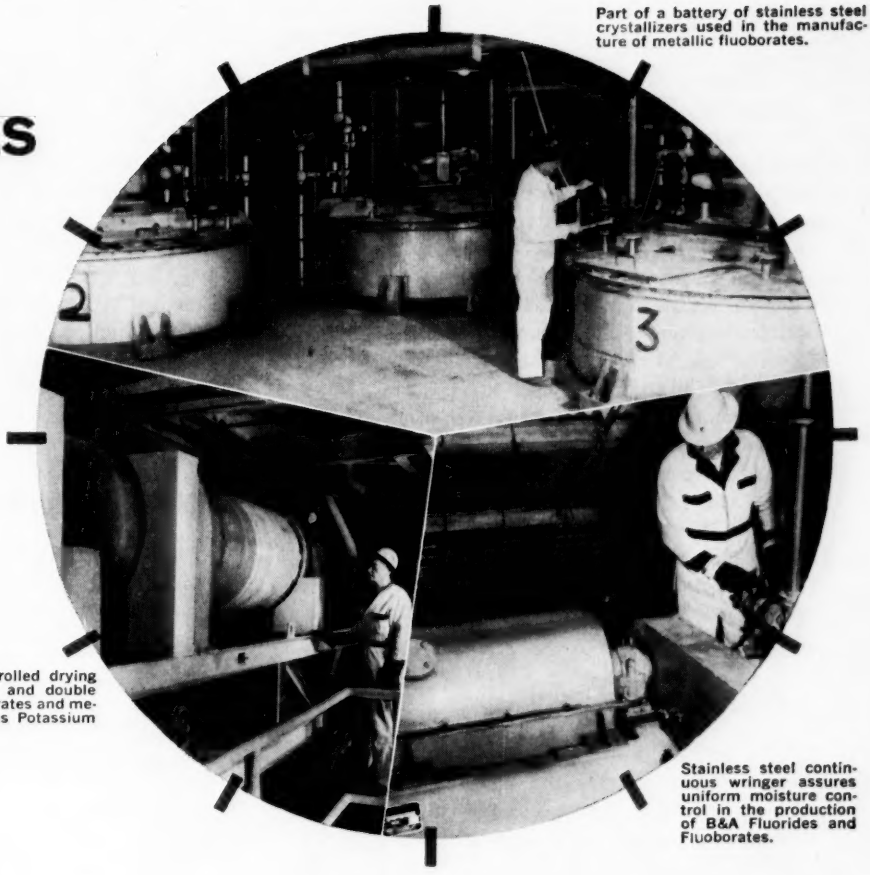

Part of a battery of stainless steel crystallizers used in the manufacture of metallic fluoborates.

Rotary dryer for controlled drying of high purity single and double fluorides, alkali fluoborates and metallic fluorides such as Potassium Titanium Fluoride.

Stainless steel continuous wringer assures uniform moisture control in the production of B&A Fluorides and Fluoborates.

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Army Ordnance Corps recently reported successful laboratory grafting of certain monomers (styrene, acrylonitrile, methacrylonitrile) onto polybutadiene, styrene-butadiene and nitrile rubbers. Technique involved mechanical working of the rubber on a roll mill with the addition of an anionic initiator, a sodium alcoholate.

Procedure, as worked out by researchers at Rock Island (Ill.) Arsenal, involves formation of the alcoholate *in situ*. A sodium dispersion is first milled with the polymer, then the monomer is added, and lastly the alcohol (e.g., propanol). Milling continues throughout the process.

Early grafting experiments were carried out by dissolving the polymer in a solvent. It was found that concentrations should be as high as possible for best results. This led to omission of the solvent entirely and use of the roll mill.

## River foam challenges researchers

Formation of foam layers several feet thick on the Thames and other rivers in England—caused by synthetic detergents in sewage plant effluents—has been stirring up a froth of political and technical effort to find ways of abating it. On the research front:

• Shell Chemical is working on a new detergent said, like soap, to be readily broken down by sewage treatment processes. Shell declines to identify chemical nature of the new product; it's believed to incorporate a key unsubstituted alpha carbon atom in the alkyl side chain.

• Researchers at Durham University report that detergents made from sugar are readily broken down by sewage processes. Drawback here is economic; sugar-based detergents, originated in the U.S. by Sugar Research Foundation and Foster D. Snell, are still too costly to replace bacteria-resistant petroleum-derived alkyl aryls. (The same is true for alcohol sulfates, which also easily yield to biological treatment.)

• British sewage plant operators are studying the wisdom of intensively aerating raw sewage so as to produce an in-plant foam in which is concentrated most of the surface-active material. This foam could then be skimmed off and disposed of, say, by incineration.

Why don't we in the U.S. have similar problems? It's simply a matter of degree, says Association of American Soap & Glycerine Producers. Our population-sewage density is much less than that of England—or of Italy, another country concerned with detergent-caused foam in its rivers.

The association has been sponsoring research in order to thwart troubles in the U.S. before they can start. Laboratory work at MIT recently led to full-scale study of new detergent disposal techniques in a Cranston, R. I., sewage plant. Results obtained so far this year have been described as a real breakthrough in the biological oxidation of alkyl-aryl detergents.

## New route to chlorine recovery

Chemical producers with byproduct HCl to spare now have another potential chlorine recovery scheme to ponder. It is based on these reactions:

$$2HCl + Ni \rightarrow NiCl_2 + H_2$$

$$NiCl_2 \rightarrow Ni + Cl_2$$

Process has been studied in the laboratory at Seattle University by chemical engineering professor David W. Schroeder. Estimated costs based on this work compare favorably with those estimated by Monsanto for the De Nora process of direct HCl electrolysis (*Chementator*, June 1, p. 33). Investment for both processes is estimated at $20,000/daily ton; Schroeder claims power consumption of only 1,300 kwh./ton, vs. De Nora's 1,750 kwh.

A workable HCl electrolysis hinges on an effective and dependable diaphragm to keep the chlorine and hydrogen apart. Finding such a diaphragm has not been easy, although De Nora has come up with an acceptable one made of polyvinyl chloride. In Schroeder's process, however, no diaphragm is needed, since electrolysis yields only one gaseous product.

In Schroeder's concept of a commercial chlorine recovery unit there are two cells (or sets of cells). One cell produces chlorine; the other, which needs no electricity, produces hydrogen. After a suitable period (say, 48 hours), there is a heavy deposit of nickel in the first cell, while the second is depleted of nickel. The roles of the cells are then reversed.

To get process feed, HCl gas is absorbed in depleted nickel chloride solution. Or if HCl is aqueous, it is simply mixed with previously concentrated $NiCl_2$ solution.

**For more on DEVELOPMENTS**.....62

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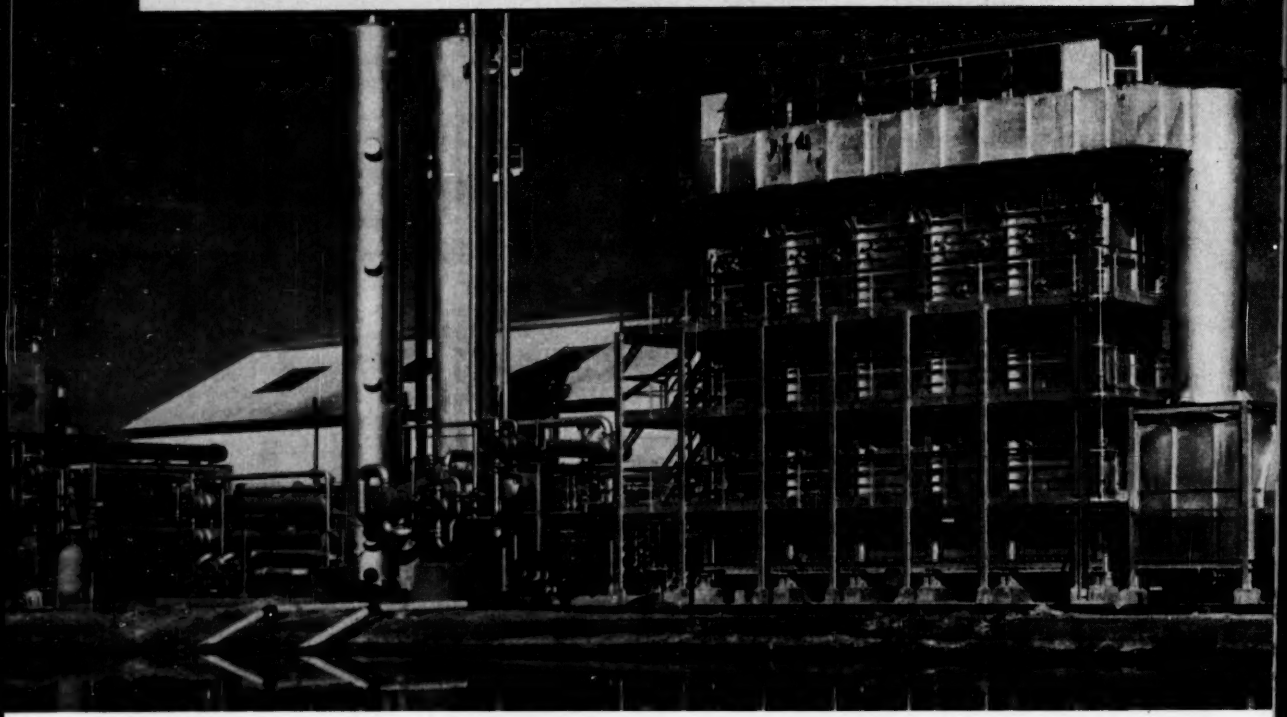


NEW steam-methane reformer (center) improves California Ammonia Co.'s production of synthesis gas.

# Uniform Heat Raises Reformer

**Improved control of heat distribution to tubes increases output of synthesis gas from new steam-methane reformer and extends tube life several fold.**

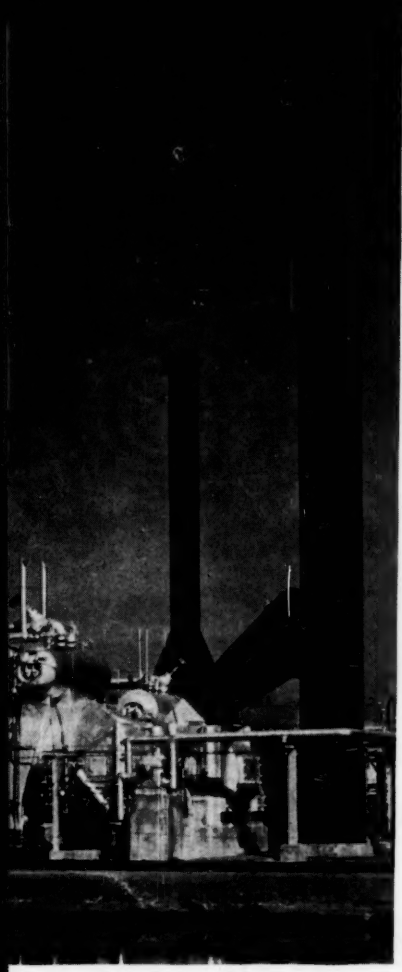
Any time that you feel a chemical process is fairly standard and conventional, watch out. Some smart engineer surely will find a way to pep it up.

A recent good example: California Ammonia Co.'s* new anhydrous ammonia plant at Lathrop, Calif., designed and erected under the guidance of consultant Jack Tielrooy, Fullerton, Calif. On stream since early January, this plant boasts a synthesis-gas section that is setting new performance levels, thanks to a new type of steam-methane reformer.

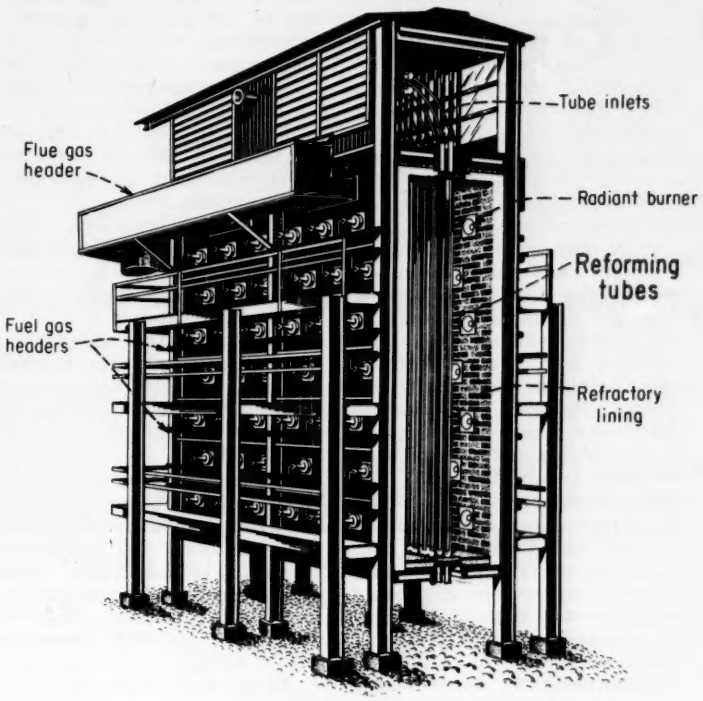
**▶Where It Shines**—According to Calamco's vice president and plant manager, Julian Rogers, the new reformer shows considerable improvement over older types, largely because it delivers more uniform and controlled heat to the catalyst tubes. Net results are higher capacity from a given tube size, lower maximum tube skin temperatures, longer tube life and greater operating flexibility.

Within six months of startup,

* California Ammonia Co. is owned in partnership by Best Fertilizers Co., Lathrop, Calif., and by a group of farmers. Using Calamco ammonia, Best produces ammonium sulfate and over 20 different grades of pelleted ammonium phosphates and dry mixes.



**Radiant burners heat reforming tubes uniformly**




# Output

after continuous operation at 110-115% of design capacity, Calamco already is thinking of boosting throughput to 130-135% of design capacity. And the reformer will operate at these rates as soon as the plant eliminates some other bottlenecks.

▶ **Others on Way**—Calamco's new steam-methane reformer, engineered and furnished by Selas Corp. of America, Dresher, Pa., is a special modification of the well known gradiation heater used in petroleum refineries and ethylene plants.

A similar unit has been operating in Germany for several years producing hydrogen from a mixed feed of methane and cracked recycle gas. And in France, Methanolacq, subsidiary of Societe Kuhlmann, is installing a Selas reformer to produce methanol synthesis gas from either natural gas or from acetylene plant off-gas.

Meanwhile, in the U. S. A., Collier Carbon & Chemical Corp., Brea, Calif., brought a new Selas steam-methane reformer to full capacity June 9, about 32 hr. after starting methane feed. Already this reformer is hitting rates higher than 130% of design capacity.

▶ **Flexible Use**—According to Selas, reformer can be designed for operating pressures from slightly above atmospheric up to 200 psig., or higher for special applications. Residual methane content of the reformed gas can be controlled precisely from 10% concentration level down to less than 0.1%.

By adding $CO_2$ to the feed gas and adjusting process conditions, Selas says that reformer can be operated to produce any specific ratio of $H_2$ to CO or $H_2$ to CO + $CO_2$, such as needed for feed to Oxo process or methanol synthesis.

▶ **Hot Box**—To get a picture of how the improved steam-methane reformer operates, let's look inside the furnace.

Furnace chamber, 43 ft. long,

6 ft. deep and 30 ft. high, contains 82 vertical cast 25-20 stainless-steel catalyst tubes, 4-in. I.D. by 5-in. O.D. by 34½ ft. long. Tubes are positioned in a staggered row running down the center of the chamber.

Heat is delivered to these tubes by 140 Duradiant burners positioned in seven rows along furnace sidewalls to provide uniform distribution pattern.

Combustion of premixed fuel gas and air takes place within ceramic burner cup which radiates directly to the reforming tubes. Both sides of the tubes receive radiant heat from the burners. There is no flame and hence no problem of flame impingement, one of the major problems leading to tube failures in older types of reformers.

▶ **Burner-Point Control**—In operating this furnace, Calamco's men get optimum temperature conditions because they can regulate each row of burners separately or individually, if needed. However, one principal feature of furnace is its operational stability and minimal need for manual adjustments. Tube wall temperatures vary only a few degrees from top to bottom, or from tube to tube.

At top of furnace, the operators adjust the rows of burners to deliver the extra heat needed to kick the entering steam and methane rapidly up to reforming temperature. Then on the lower level, they adjust the rows of burners to deliver heat that will maintain reaction without overheating the tubes.

By controlling the tube-wall-temperature pattern carefully, Calamco has been able to increase the throughput of gas, yet avoid excessive tube-wall temperatures which shorten tube life. Tube life is expected to extend for 10 yr. or longer.

▶ **Minimum Attention**—Actually, once initial adjustments are completed the furnace needs little attention. Flows of process gas, fuel gas and steam are controlled automatically. If needed, the furnace operator can reset the flow recording-controllers according to temperature and methane content of reformed gas.

Temperatures are measured in various parts of the furnace chamber, at the outlet of every sixth tube and at the end of the outlet header. An infrared analyzer records methane in outlet.

Thermal efficiency for the reformer and flue gas waste heat boiler runs close to 85%. The waste heat boiler generates most of the steam for reformer.

▶ **Into Reformer**—To produce synthesis gas for conversion to ammonia, Calamco takes natural gas at 200 psig. and passes it through activated carbon to remove organic sulfur compounds. Then, gas mixes with three parts by volume of 250-lb. steam and is heated to 750 F. by heat exchange with effluent from the shift converter, which follows the reformer.

Leaving the preheater, steam-methane mixture at 125 psig. flows down through the reforming tubes which contain active nickel oxide catalyst at 1,600 F. Reformed mixture discharging from furnace at approximately 1,400 F. and 110 psig. contains (water-free basis) 72-74% $H_2$, 8-9% $CO_2$, 13-14% CO and 5-6% $CH_4$.

▶ **Quench and Convert**—At the reformer outlet, gas-steam flow is cooled to about 800 F. by combined steam and condensate quenching. Additional steam picked up by reformed gas during cooling satisfies steam requirement for shift conversion of CO to $CO_2$.

In the shift converter, steam-gas mixture flows through two beds of chromium-promoted iron oxide catalyst with steam cooling between beds. Typical composition of gas leaving the shift converter is 75% $H_2$, 2% CO, 18% $CO_2$ and 5% $CH_4$. Mixed with this gas is approximately an equal volume of steam.

During three stages of cooling, this steam-gas mixture preheats reformer feed, provides all reboil heat for the MEA system and preheats boiler feed water.

▶ **Purify and Synthesize**—Cooled crude hydrogen is purified by scrubbing with MEA and caustic soda to remove $CO_2$, by dehydrating over activated alumina and by scrubbing with liquid nitrogen to remove $CH_4$ and CO. The latter components are recovered as usable fuel.

Purified hydrogen mixed with nitrogen from air fractionation feeds into stream of synthesis gas recirculating in ammonia synthesis plant. Conversion to ammonia is completed in a low-pressure system.

## Unit Operations on Board The N. S. Savannah

Launched last month, the world's first nuclear-powered merchant ship, N. S. Savannah, is a floating chemical processing plant too. N. S. Savannah's power plant embodies some six chemical engineering unit operations, is typical of many nuclear-power plants being built today (see pp 123-128).

Power plant consists of a 74,000-kw. pressurized-water reactor (PWR), to be fueled with 8,060 kg. of uranium dioxide. Auxiliary equipment will process cycling coolant and handle liquid and gas wastes. Reactor was developed and fabricated by Babcock and Wilcox Co. of New York, N. Y., reactor constructor for the Indian Point PWR.

▶ **Going on Stream**—When the Savannah begins operating, a side loop will withdraw 20 gal./min. of coolant from the primary loop, will purify the stream by ion exchange and filtration to remove fission and corrosion products. Purified water will reenter the primary loop via positive-pressure seals at the control-rod drives. Hydrogen, added to the primary loop, will maintain a minimum concentration of 20 cc./l. of $H_2$ to scavenge oxygen liberated by irradiation of coolant water.

Two separate evaporator-ion exchange units will produce pure water from sea water, required for coolant cycle makeup and passenger consumption.

Liquid wastes will be stored in a 10,000-gal. tank and later discharged to the sea in weighted sea-chests, as soon as international agreement will permit. Gaseous wastes, resulting from possible fuel element rupture, will be burned in oxygen and stripped of radioactive content by cold adsorption on −280 F. charcoal. An intermediate coolant loop will provide heat transfer media for the auxiliary processes.

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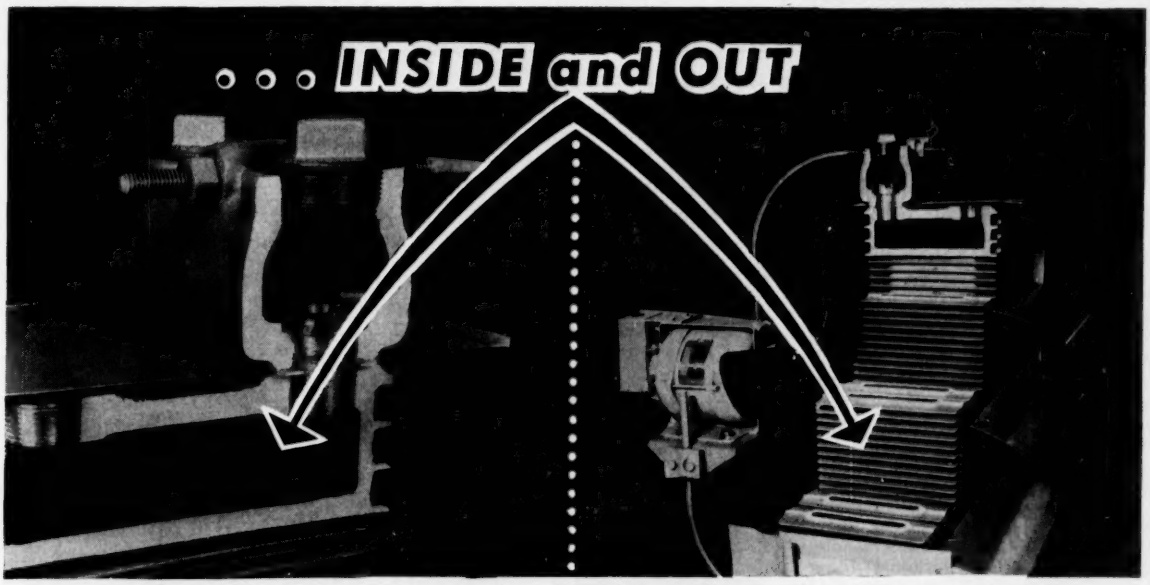


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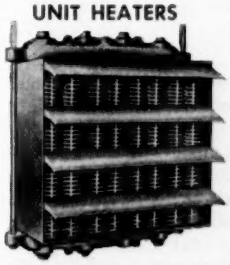

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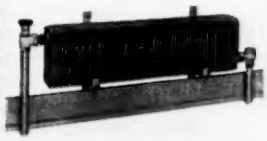

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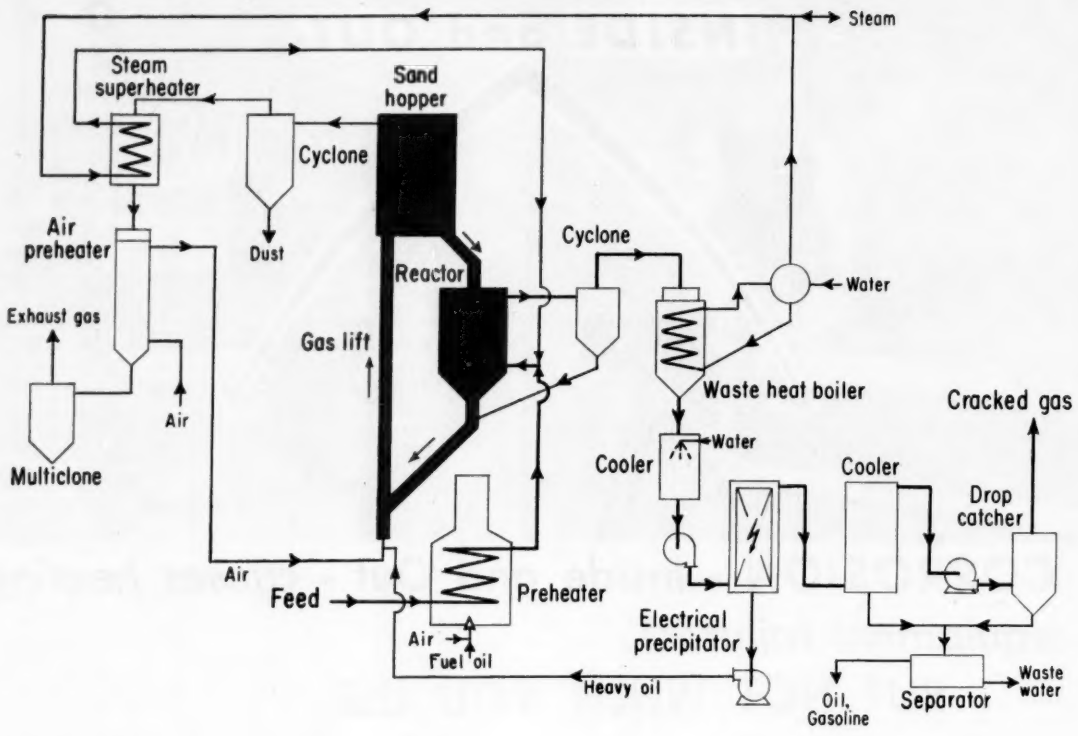



# Sand Broadens Thermal Cracking Range

**Using fluidized sand to transfer heat, thermal cracker produces a higher yield of olefins, broadens feedstock and temperature ranges.**

To improve cracking of petroleum-derived feedstocks to olefins, Erdoelchemie, GmbH. (jointly owned by Farbenfabriken Bayer and British Petroleum) recently came on stream with a completely new type thermal cracker at its petrochemical plant in Dormagen, Germany. Output of plant will total up to 20,000 tons/yr. of ethylene or an over-all production of 35,000 tons/yr. of $C_2$-$C_4$ olefins.

▶ **Extends Boundaries**—Erdoelchemie's cracking unit surpasses accepted thermal cracking practice because it transfers heat more effectively. Utilizing circulating fluidized sand to deliver needed heat, the unit extends cracking capabilities far beyond the boundaries imposed by conventional steam crackers.

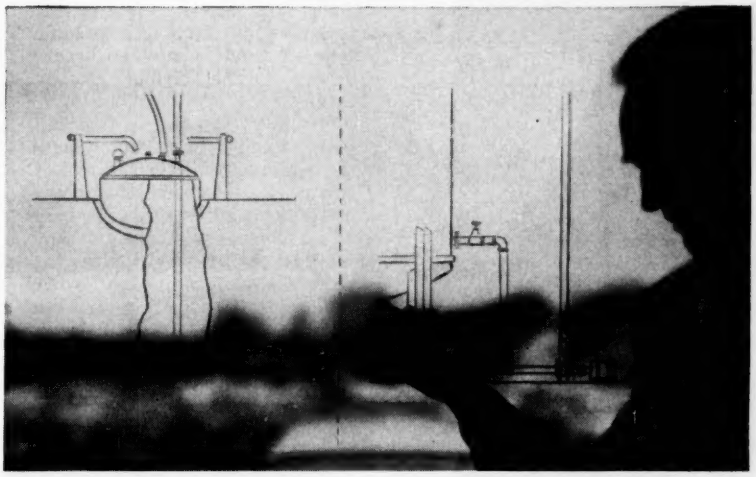
In common with steam crackers, the sand cracker will process liquefied gases and gasoline with boiling points that range up to 305 F. But, in addition, the sand cracker accepts higher-boiling distillates and crude feedstocks. Thus, the operator can adapt choice of feedstock to oil market conditions.

If a steam cracker tries to use these higher-boiling feedstocks, it runs into stiffer maintenance charges to cope with formation of coke in the tubes. Similar trouble results from attempts to process low-boiling hydrocarbons at higher cracking temperatures.

However, coke formed in the sand cracker deposits on the sand particles and burns off dur-

# BRIEFS

**on a useful manual on handling caustic soda . . . phosphorus chlorides for organic synthesis . . . a special plasticizer for vinyl plastics**



## Caustic soda handling from tank car to process

An authoritative study of this subject is covered in our *Caustic Soda Engineering and Handling Guide*, a 40-page manual designed for engineers.

This manual puts at your finger tips the essentials on handling and storing liquid caustic soda, with emphasis on safety, efficiency, and minimum contamination.

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**Phosphorus oxychloride.** A clear, water-white liquid, typically 99.8% pure. Only 0.01% phosphorus trichloride. No free chlorine or phosphorus pentachloride. Iron at less than 1 ppm.

**Phosphorus trichloride.** Also a clear and water-white liquid. 99.9% pure. No free phosphorus.

**Phosphorus pentachloride.** Often used in pilot work and other areas where only small quantities are involved. Not only more reactive than the trichloride, but offers the convenience of a powder form for use in small reactors. No phosphorus trichloride or nickel. 1 ppm lead. 2 ppm iron.

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- ☐ Phosphorus Trichloride Data Sheet
- ☐ MPS-500 Bulletin

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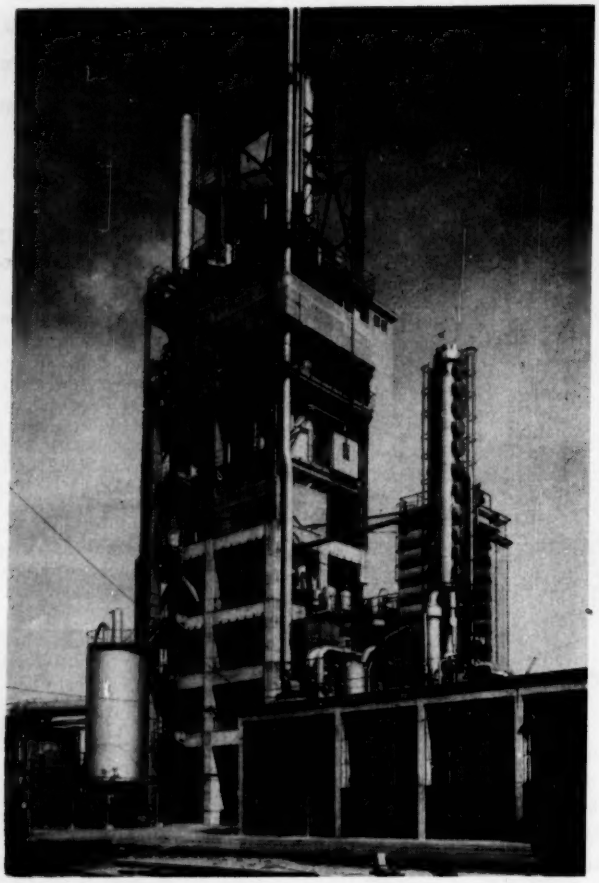

**FIRST fluidized sand cracker produces olefins for Erdoelchemie in Germany from broad range of petroleum feedstocks.**

ing reheating of the sand. So, there is no coking problem and cracking temperatures can be regulated to optimize yield.

By varying these temperatures over a broad range, Erdoelchemie can change the ratio of propylene to ethylene from 0.3 to 0.8 without reducing the optimum yield of total $C_2$-$C_4$ olefins. Ratio can be extended either side of this range by accepting a drop in olefin output.

▶ **Yield Jumps**—Proof of improved yield is 30-35% return of ethylene from gasoline feedstock. By contrast, a steam cracker is forced to hold yield down to 22% to avoid the danger of excessive coke deposits.

When operating on liquefied gas feed, use of lower temperatures and recycling of the uncracked gases facilitate an even higher yield of ethylene. Ethane can yield up to 80% ethylene.

Composition of the cracked gases does not change appreciably with a change in feedstock, with the exception of ethane. Therefore, feedstock changes do not force any modification of the gas separating plant.

▶ **Joint Development** — Sand cracking was developed jointly by Lurgi Gesellschaft fuer Waermetechnik and Ruhrgas AG Essen in cooperation with Farbenfabriken Bayer AG. Unit at Erdoelchemie, GmbH., was constructed by Lurgi based on 1-ton/hr. pilot plant operation by Bayer at Leverkusen.

At Erdoelchemie, hydrocarbon feed is preheated to 790 F. in a tube furnace, mixed with superheated steam and injected into reactor. Stream of hot sand flowing into reactor maintains temperature at 1,400-1,650 F.

Feed stream circulates the sand rapidly in the reactor bed, maintaining uniform temperature at which gases crack spontaneously within 0.4-0.6 sec. This fast reaction favors the formation of olefins. At the same time, it hinders further breakdown of the olefins already formed.

▶ **Product Stream** — Cracked gases leaving the reactor pass through a cyclone for removal of entrained dust. Next, they enter waste heat boiler giving up heat to make process steam.

Injection of water into gas stream leaving waste heat boiler condenses high-boiling cracked residues. Electrostatic precipitator knocks these out of gas stream for recycle as fuel to heat sand.

Leaving precipitator, gases are cooled further in a tube cooler and fed to a gas separation unit. High olefin content of the cracked gases makes easy both separation of the gases and concentration of olefins. Carbon dioxide content of these gases is very low; there is no oxygen.

Coming out of the gas separation are streams of ethylene, propylene, $C_4$ olefins, richly aromatic hydrocarbons and residue gases consisting mainly of methane and hydrogen.

▶ **Flowing Sand**—During cracking of the hydrocarbons in the reactor, coke skin forms on the sand grains. Discharging from the bottom of the reactor, the coated sand is 200-300 F. cooler than hot sand entering at top of reactor. Unbroken flow of sand down drop leg from reactor to gas lift keeps cracked gases from mixing with air or combustion gases.

At bottom of drop leg, sand enters gas lift. Injection of high-boiling residues, recovered from cracked gases, into entering 1,000-F. air stream burns coke off sand and lifts particles into supply hopper.

Leaving top of hopper, gases are cleaned free of entrained dust by cyclone. Heat content of the gases is utilized to produce process steam and preheat air for gas lift.

**FLO-BALL 715 makes needle valves obsolete**

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Ideal for leakproof control of air, vacuum, steam, water, fuels, oils, kerosene, alcohol, etc., the ***FLO•BALL*** features zero leakage, universal mounting, removable flanges, and all stainless steel construction.

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## Hydromatics, Inc.

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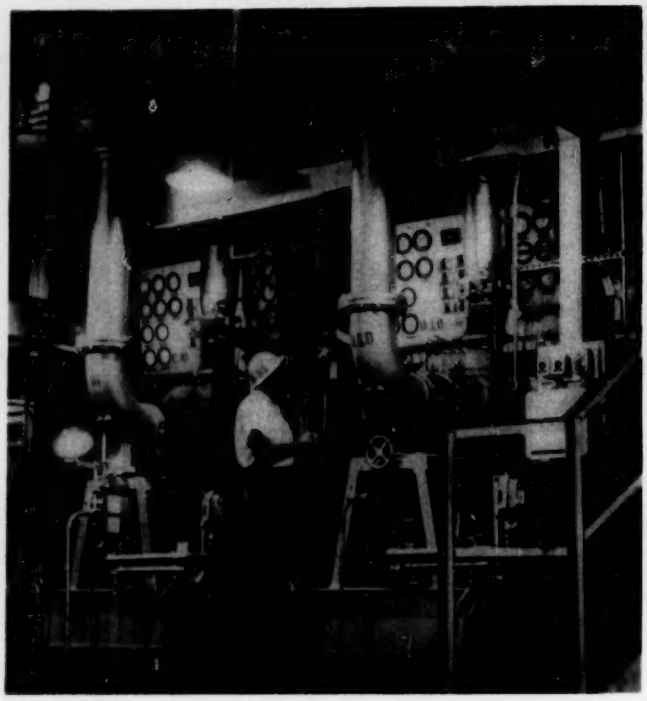


**Big Turboexpanders Help Liquefy Hydrogen**

**These two large newly designed expansion turbines efficiently remove energy from hydrogen gas at low temperature to assist in low-cost liquefaction at Air Force Plant No. 74, built and operated by Air Products, Allentown, Pa. (*Chem. Eng.*, June 15, 1959, p. 82.) Extreme high-speed expanders remove energy to produce refrigeration at −423 F.**

## Relativity Check Will Rely on Two Chemicals

When the National Aeronautics and Space Administration fires its proposed atomic clock into orbit around the earth, credit can be given, at least partially, to two chemicals—one ammonia, the other undisclosed.

Purpose of the clock will be to check Einstein's special theory of relativity by comparing its "ticks" with those of a similar but earth-bound clock.

The clock, an ammonia mazer (microwave amplification by stimulated emission of radiation) being developed by Hughes Aircraft Co., makes use of induced energy change in ammonia molecules which gives off constant-frequency energy. Nitrogen-15, costing about $400 a gram, is used in the ammonia because its molecular configuration insures a more constant energy.

An undisclosed material of construction in the vacuum chamber will act as a chemical vacuum "pump," reacting with ammonia to form a solid, thus maintaining a vacuum in the entire system.

## Firm Begins Study of Sulfite Pulping Routes

New developments and the great flexibility of sulfite pulping processes now make it necessary to re-evaluate these routes.

Nearly 20 U. S. and Canadian companies have now subscribed to underwrite the cost of a technical and economic evaluation by Arthur D. Little, Inc., to help a company choose among the many sulfite-pulping and spent-liquor-treatment systems now available.

Studies will involve weighing relative merits of each pulping and spent-liquor-treatment process for different mill situations, as well as comparing the most promising of these with the sulfate process.

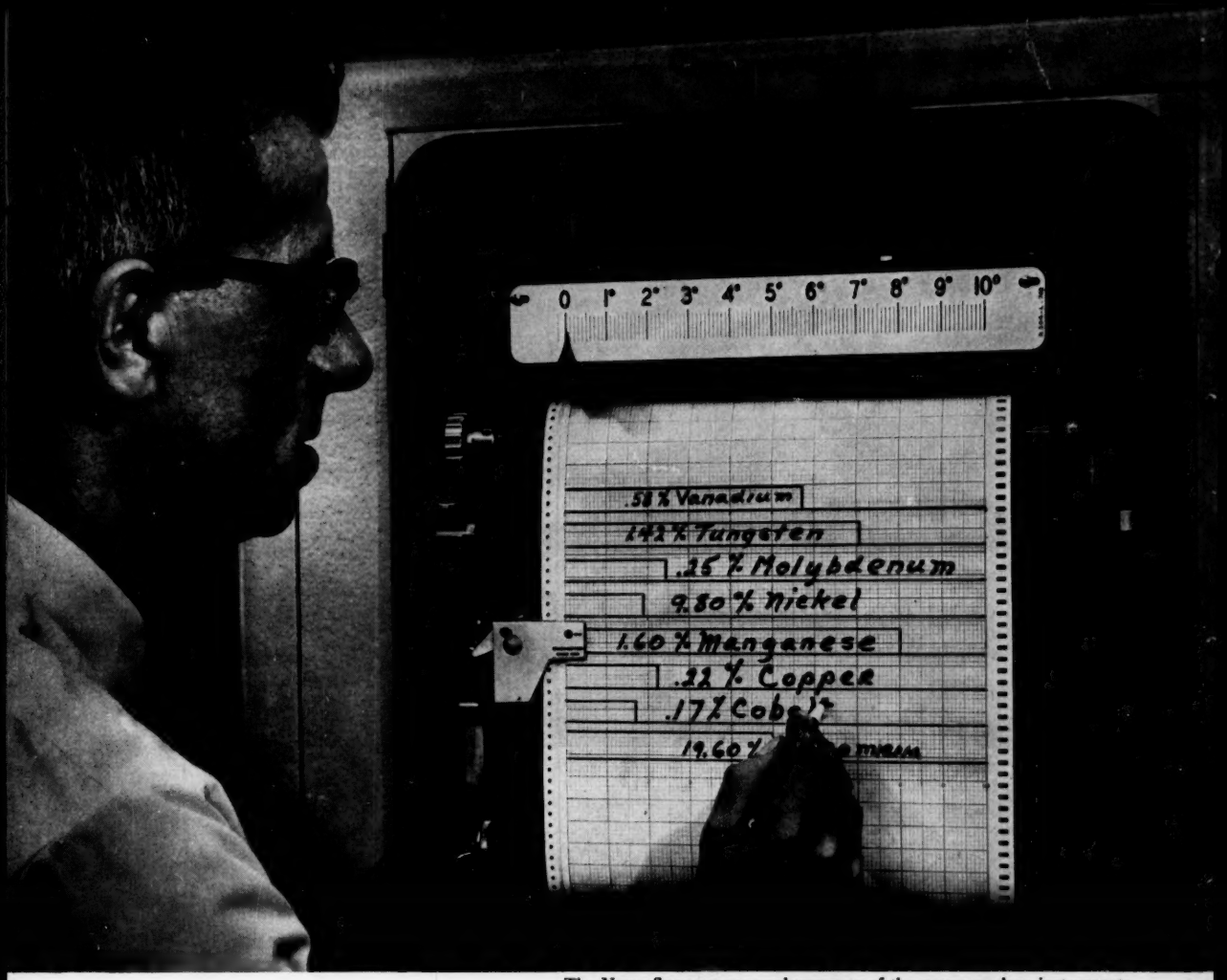
ADL will also develop criteria to evaluate specific mill situations and will formulate research and development programs of long-term benefit to the sulfite-pulping industry.

## Bureau of Mines Plans Second Plowshare Meeting

Responding to industrial interest in the U. S. proposed experiment with nuclear blasting in underground oil-shale deposits, Bureau of Mines plans to invite petroleum and chemical producers to another meeting to discuss oil-recovery proposal further.

Director M. J. Ankeny explains that this is because of industry's "generally favorable" attitude toward the experiment. Twenty-one major petroleum and chemical companies have replied to a government poll of opinions on the project, and all except two indicate they think the project should go on.

"And several," said Ankeny, "expressed willingness to participate and help finance at least part of the project." According to Ankeny, four companies suggested that the bureau make preliminary tests with conventional high explosives before the underground nuclear shot.




The X-ray fluorescence analyzer, one of the many modern instruments in the chemical laboratory, helps Jessop make certain you get the specified per cent of each alloy in your specialty steel.

# "How X-rays help Jessop give you exactly what you want in alloy steels . . ."

—C. M. Carlisle, Director of Analytical Chemistry

**"What's happening here?** As the stylus in the X-ray fluorescence analyzer draws red lines on the graph, the Jessop chemist determines the exact per cent of each alloy in a sample of specialty steel.

"Based on this analysis, the melter may ask for the addition of, say, molybdenum to the molten steel now in electric arc furnace No. 3.

**"How's it done?** Bombarded by X-rays, the alloys in the sample of steel are radiating secondary rays. Converted into electrical energy, the rays are causing the stylus to move and draw red lines on the graph . . . indicating the types and per cent of alloys in the steel sample."

**In the Jessop chemical laboratory,** the X-ray fluorescence analyzer and many other modern instruments help us make certain you get the exact chemical composition specified in your order. This chemical laboratory is one more reason for your confidence in ordering specialty steels from Jessop. *Specify Jessop . . . and then relax!*

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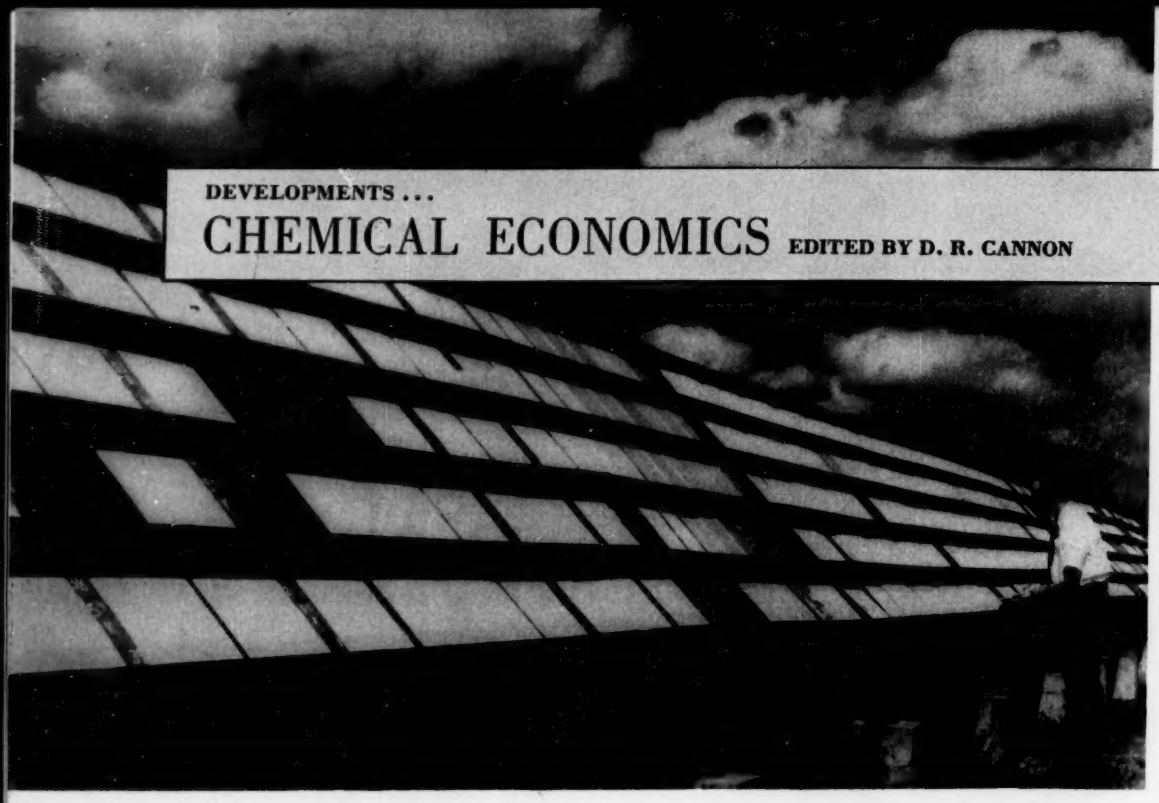


DEVELOPMENTS ...

## CHEMICAL ECONOMICS

EDITED BY D. R. CANNON

# Latex Paints Pass New Tests

**Not satisfied to stay at home indoors, they're making the grade in industrial finishes and on outdoor structures.**

**Frances Arne, Assistant Editor**

Water-based latexes remain the liveliest actors on the paint scene. Commercially introduced little more than a decade ago, they've revolutionized indoor painting, making do-it-yourself a national byword.

Having caught their breath and submitted to further product development, they're now making their move toward other major industry markets: exterior use over masonry and, most recently, over wood; industrial use over metals in appliances, industrial and office equipment, public transport and industrial vehicles as well as automobiles.

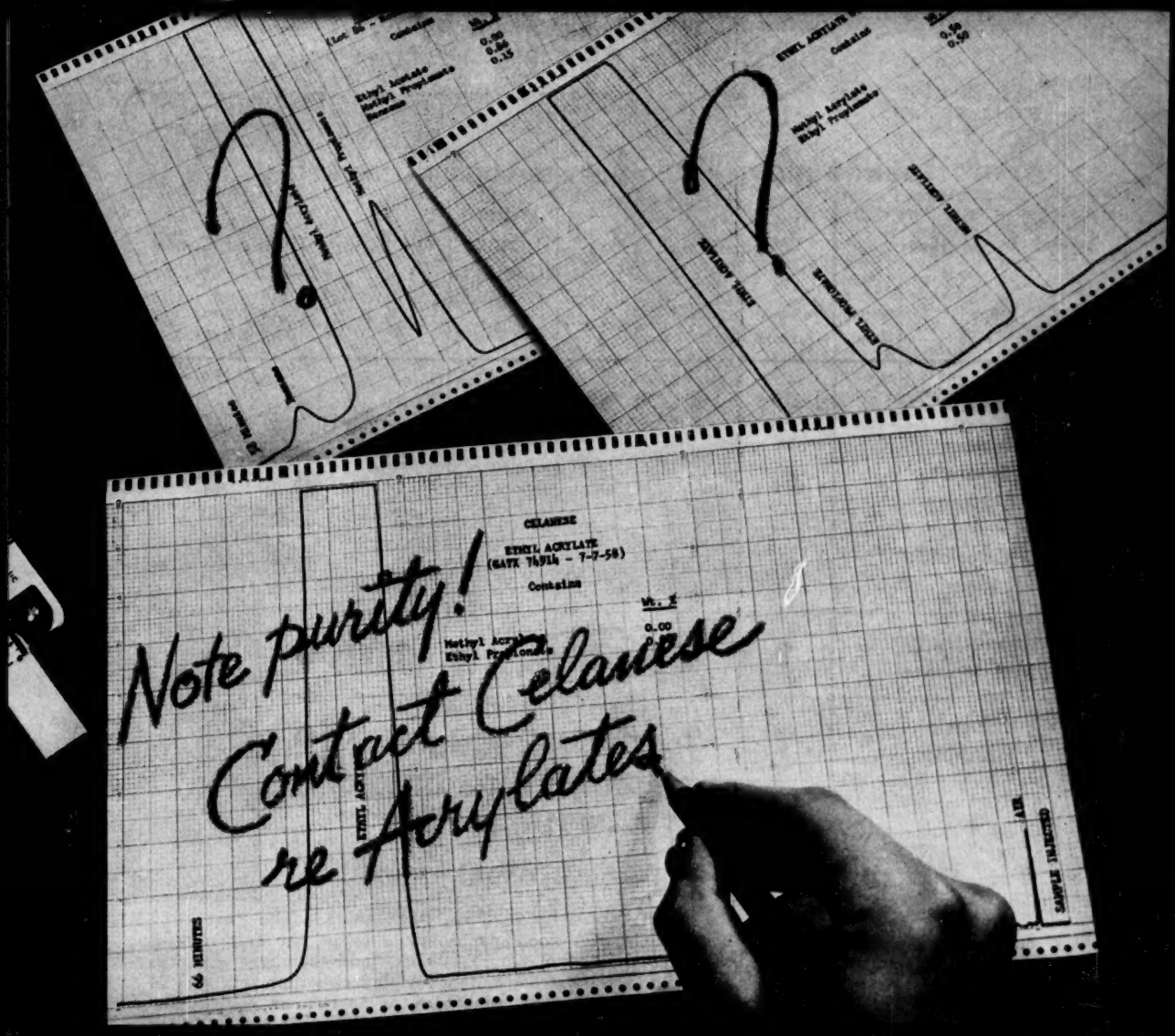
Though they're too new in these markets to dent current sales figures, there is widespread industry expectation that here, too, penetration of water-based latexes will border on the revolutionary. Answers to the question, "when," run all the way from two to ten years.

To date, latexes have expanded largely at the expense of casein-, alkyd resin- or oil-based paints. Do-it-yourself indoor painters have been attracted in droves by ease of application with brush or roller, absence of odor, ease with which spills and brushes can be cleaned up with soap and water, tough and washable finished coatings.

Now the latexes are beginning to nibble cautiously at oil paints for exterior use and at alkyds for industrial finishes. Outdoors the attractions are, again, ease of application and clean-up for the amateur plus quick dry, ability to apply and dry shortly after rain, and long-lasting, blister-resistant finish. For industry, they remove the fire and air pollution hazards of solvent-based paints.

In 1958, sales of the latex paints were about 65 million gal., up from 60 million in 1957. They were worth about $320 million. Indoor use accounted for about 80%. But barn-broad targets presented by segments of the industry where latexes are not yet significant factors dwarf these figures. Gallonage of latex paints is expected to rise to 92 million by 1962.

▶ **Latex Stronghold**—Of the total paint market, 40% is trade

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In Canada: Canadian Chemical Company Limited, Montreal, Quebec.
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## Water paints move up in volume coatings markets

| Markets | | Water-Based Latex | | | Water-Thinned Coating | Solvent-Thinned Coating | | | |
|---|---|---|---|---|---|---|---|---|---|
| Specific Use | Percent Total | Polyvinyl Acetate | Styrene-Butadiene | Acrylic | Alkyd | Acrylic | Alkyd | Styrene-Butadiene | Oil |
| Interiors | 27 | ▲ | ● | ● | ? | Not a factor | ▼ | Not a factor | ▼ |
| Exterior Masonry | 13 | ▲ | Not a factor | ▲ | Not a factor | Not a factor | ▼ | ▼ | Not a factor |
| Exterior Wood | | ▲ | Not a factor | ▲ | ? | Not a factor | ● | Not a factor | ● |
| Industrial Maintenance | 20 | ? | Not a factor | ? | Not a factor | ? | ● | ● | Not a factor |
| Industrial Finishing | 40 | ? | ? | ▲ | ▲ | ▲ | ● | Not a factor | Not a factor |

▲ Good growth; under way or potential. ▼ Significant use; decline under way or potential.
● Significant use; likely to remain stable. ? Potential undefined.

*Courtesy Celanese Corp. of America*

sales, mostly exterior and interior paints such as those used in homes. The ratio is about 2 to 1 in favor of interiors. Here is the established latex stronghold. But some masonry and most wood exteriors are still latex-free and about as many interiors remain unlatexed as latexed.

▶ **New Territory**—Another 20% of the industry total is industrial maintenance paints. The remaining 40% is industrial finishes, most of them coatings for metals, many of them high-gloss top coats. Of this 40%, 5 to 6% covers original automotive equipment.

▶ **All-Purpose Pitch**—Hopes of billing products as general-purpose or all-purpose paints spurs much current product development effort in the latex field. Manufacturers could simplify both distribution and use of paints if they could recommend the same basic types of paints for indoor and outdoor use, as one-coat or self-priming products, over wood or masonry or metal.

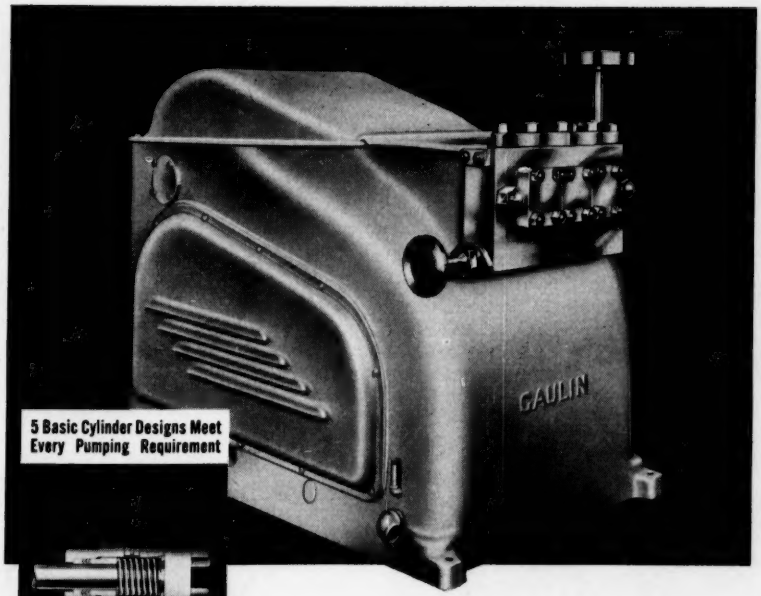
While this strong pitch for knocking off several new markets at one clip presents bright vistas to acrylic and PVAc paints, it works to the disadvantage of styrene-butadiene paints which do not stand up to outdoor weathering.

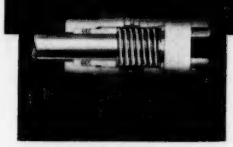
▶ **Acquiring Gloss** — Building gloss into latexes—which originally appeared in flat paints—has been the object of considerable research. Gloss coatings represent over half the gallonage used in industrial finishes and about a sixth of interior and exterior house paints.

Two years ago Celanese announced development of a PVAc resin which formed a suitable base for high gloss trade sales formulations. Rohm & Haas just announced an acrylic emulsion suggested for water-based-formulation of high gloss top coats over industrial metals.

▶ **Fair-Haired Polymer**—For the present, at least, acrylics appear to be the fair-haired polymer and their position is improving faster than that of PVAc. It is acrylic on which four major paint companies elected to base their new water-borne paints for exterior wood. In the department of handwriting on the wall re all-purpose paints: It may be significant that one of the companies is Glidden with resin supplied by Dow, new to the acrylics field. This is the same combination that was an early winner in the styrene-butadiene interior paint field. Pittsburgh Plate Glass—not one of the four large producers already marketing acrylic house paints—reports that it has just completed extensive comparison testing with acrylic house paints against oil types and is convinced of the relative merits of the former.

Also, it is the acrylics that are most vigorously pushing their way into industrial finishes. Styrene-butadiene coatings are making some penetra-



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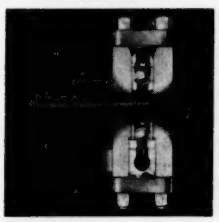
Packing adjusting screw style stuffing box

Poppet Valve, stainless steel

Ball valve, hardened inserted valve seat



Ball valve, removable seats

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tion as primers. The new Rohm & Haas acrylic emulsion, however, is suggested for both primer coats and gloss top coats.

Although galvanized iron and other corrosion-resistant metals can be painted successfully with PVAc coatings, they do not provide as hard a finish as acrylic coatings and they transmit water more readily. Their use might encourage rusting of the metal surface beneath the paint film.

▶ **Automotive Finishes** — The field of automotive finishes has undergone a revolution since World War II and seems headed for another. The dry oil alkyd enamels were replaced by nondrying or alkyd resin cured with melamine resin. Within the past three or four years, nitrocellulose lacquers were replaced with solvent-borne methyl methacrylate lacquers, which thus gained about half of the passenger car market.

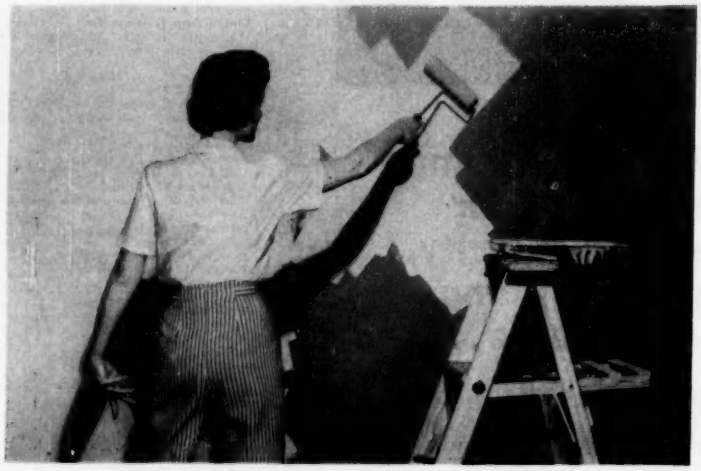
But informed sources on all sides, loud among them principal suppliers of the incumbent acrylic lacquers such as Du Pont and Pittsburgh Plate Glass, predict another quick change. According to Du Pont, five years from now the whole automotive industry will have gone over to water-dispersed methacrylate polymers. According to a PPG official, an extensive use of corrosion-resistant metal primers based on water paint systems is expected during 1959, with the automotive industry regarded as the biggest consumer. Pittsburgh Plate's research in this field, he reports, has resulted in some interesting new developments in water thinnable primers and the company will supply sizable quantities to automobile manufacturers.

Over a year ago, the Lincoln Div. of Ford started using a water-based styrene-butadiene dip-coat primer, Rohm & Haas recently introduced the aforementioned acrylic resin emulsion described as suitable for high gloss top coats for metals in a wide range of industrial applications including automotive.

▶ **Industrial Finishes** — In the over-all industrial finishing market, water-based latexes are up against not only solvent-based but also water-based alkyds. Reichhold and American Cyanamid have been selling resin bases for the latter products for several years.

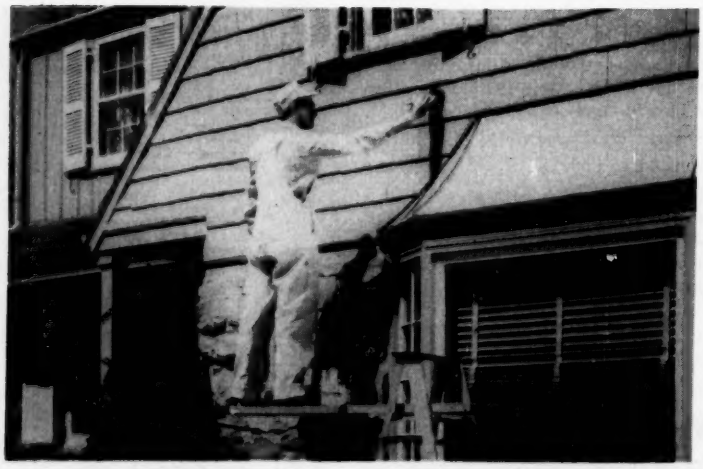
Alkyd entrenchment is still formidable though some estimates on sales of dry resin have them down from 400 million lb. in 1959 to 380 million in 1960. Gallonage of oil paints is expected to rise from 200 million in 1959 to 220 million in 1960.

Competing at the premium-quality-finish level are thermosetting acrylic resins, introduced by Pittsburgh Plate Glass about five years ago as a new and unique resin family. In solvent-thinned coatings, these resins are said to be unmatched for demanding household appliance applications by either the amine-alkyd resins or by the



Latex Paints Pass New Tests

**INDOORS,** where 80% of them are now used, their stronghold is based on ease of application and clean-up.



Latex Paints Pass New Tests

**OUTDOORS** they perform well over masonry and are finding new acceptance for use over primed wood.

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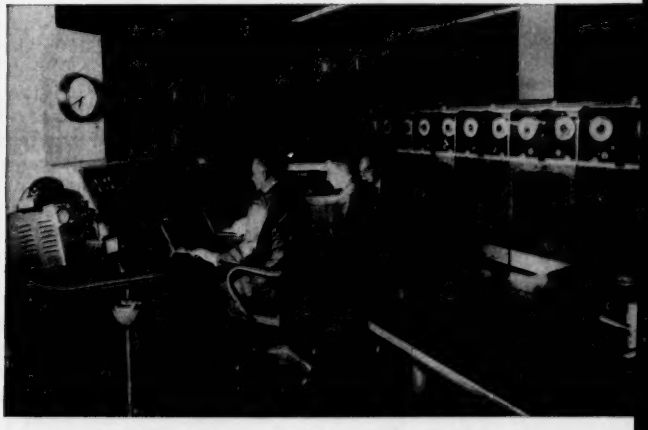

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Latex Paints Pass New Tests

**IN INDUSTRY** they're already getting use as dip-coat primers, may take over the whole auto-coating market.

epoxy types. In recent years, several other resin suppliers have come out with their own version of acrylic thermosets.

▶**Solutions Vs. Emulsions**—Water soluble vs. water emulsion is the subject of a lot of paint industry conversation these days. Raw materials are available, e.g., Archer-Daniels-Midlands' Arolon 1000 and resins made from Amoco's trimellitic anhydride, and there has been a little use of water solutions in industrial finishes. Research on water solutions involves all the synthetic resins used in paints, including the alkyds.

Solution technology is in some ways less tricky than that of emulsions. On the other hand, viscosity of polymers in latex form is independent of polymer molecular weight or composition whereas resins applied from solvents must be limited in molecular weight and composition to achieve solvency and reasonable viscosity.

Another possibility for technical shift in the water-based paint field is that a new material, probably a copolymer of one or more of today's monomers, will move in.

▶**Whole Picture** — Total paint market in 1958 is estimated by the Bureau of the Census at $1.629 billion compared with $1.604 billion in 1957. In gallonage, 1958 was worth 612 million.

Sherwin-Williams estimates for *CE* that sales and production of pigments and colors and synthetic resins this year will be 8 to 10% better for the entire paint industry than in 1958. The National Paint, Varnish & Lacquer Assn. expects growth to continue fast enough so that the industry breaks through the $2-billion mark during the '60's.

Growth curves for the period 1952-1958 show a marked leveling off for styrene-butadiene latex paints while polyvinyl acetate and acrylic emulsions show good progress. Their respective percentages of 1958's total latex gallonage of 65 million were about 59; 29; 12. In 1957, it was 65; 26; 9. Most observers agree that PVAc and acrylics will continue to grow at a faster rate than styrene-butadiene.

▶**Inside & Out**—The problem of resin stability when exposed to light and weathering has held back the use of styrene-butadiene latex for exterior paints.

Acrylic and PVAc paints, in fact, got their start in this country in outdoor masonry on the basis of styrene-butadiene shortcomings outdoors plus the fact that conventional oil-based paints are sensitive to alkali, and masonry is highly alkaline.

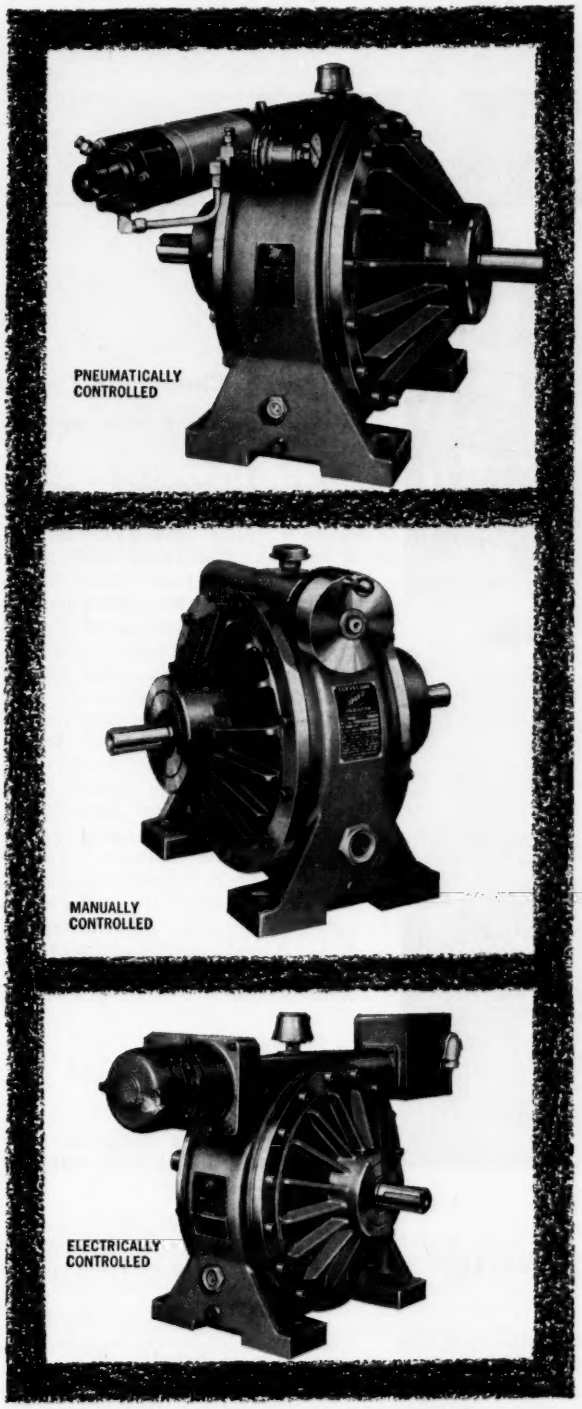
▶**Primers Eliminated** — This same compatibility with alkaline surfaces prompted an early indoor market for PVAc and acrylics as primer-sealers for new plaster, etc., prior to application of oil and alkyd top coats. More recently, it has been lending support to the idea of latexes as two-coat self-priming paints or even one-coat paints.

▶**Tapping Wood** — In recent months, several major paint manufacturers — Glidden, Du Pont, National Gypsum and John Lucas Co.—have come out with acrylic latex paints for use over exterior wood. In many types of wood, temperature and humidity changes cause extreme dimensional changes. Latex paints in their earlier days did not possess the extreme flexibility and adhesion when formulated with large amounts of pigments, and would crack on prolonged exposure.

Manufacturers of the new acrylics for wood have licked the problem to the extent that they're predicting that their paint films will stand up 50% longer than oil-based films. However, they're all recommending use of special primers which, for new wood, are oil- or alkyd resin-based. Further research is being carried on in order that a complete water-borne system can be made possible in the next few years.

Formulation development work on the part of PVAc interests is expected to put paints based on these resins, too, on the exterior wood market. On the flat basis of dry resin price, PVAc falls on the low side of the middle. Homopolymers are about 29.1¢/lb. and copolymers 32.7¢/lb. vs. acrylics at 42.4¢/lb., styrene-butadiene at 29.5¢/lb. Acrylics were at first held back somewhat by higher cost. However, it is now generally agreed that these inequities can be reduced by formulation.

A clean-cut advantage PVAc does have was pointed out to *CE* by both Du Pont and Celanese: It is easier to formulate a good paint from PVAc than from the other resins. Celanese believes this makes PVAc particularly attractive to small formulators without substantial background in emulsion technology.

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Infinitely variable speed regulation is provided with instant, smooth change by either manual, automatic, or remote control. Precise adjustments are easily made with accurate adherence to settings. Some typical examples:

**For the Chemical Industry**

In rubber processing seventeen variators provide necessary process flexibility when changing production from one type synthetic rubber to another.

**For the Automotive Industry**

Variators give accurate control of assembly line speeds to control conveyor output rates.

**For the Tobacco Industry**

Variators make delicate adjustments for electronic beta gage controller.

**For the Steel Industry**

Variators provide remote control speed change on processing line conveyor.

**For the Metal Working Industry**

Variators permit fast, accurate adjustment of machining speeds for metals, from magnesium to 38 Rc steel.

**For the Wire Products Industry**

Variators control four reels simultaneously — and without slippage.

**In Ore Processing**

Variators easily adjust rate of material feed to hammermill.

**In Material Handling**

Variators control movement of steel tubes through 176-roll annealing furnace.

**The Cleveland Worm & Gear Company**
***Speed Variator Division***
**3275 East 80th Street, Cleveland 4, Ohio**

A subsidiary of
Eaton Manufacturing Company

*Sales representatives in all major industrial markets.*

*Send for your free copy of Bulletin K-250. It gives the complete Variator control story.*

**HOW IT WORKS**

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, right).

**CLEVELAND**
**VARIATOR**

DEVELOPMENTS . . .

# CHEMICAL PRODUCTS

EDITED BY FRANCES ARNE

## Plastisol Mold Copies Carvings

Molds made from vinyl plastisol are now used to form precise duplications of hand-carved stone work in mass-production quantities and at low cost.

A sand mold is made from a pattern of the stone work desired and an aluminum master mold is cast with integral stainless steel tubing for later heating and cooling. The plastisol is poured into the preheated aluminum mold and allowed to jell. After the vinyl has cooled, it is stripped from the mold and a durable vinyl mold results. Concrete can then be poured into these for mass-production forming.

Costs of the vinyl molds is considerably less than the wood molds conventionally used. Other advantages: Vinyl molds are flexible, can be peeled off the undercuts; vinyl surface of the molds can be made to duplicate almost any finish.—**B. F. Goodrich Chemical, Cleveland. 80A**

### Nitrogen Chemicals

**Two dozen new fatty nitrogen chemicals.**

Now available are 24 new fatty nitrogen chemicals including four primary, five secondary, and three tertiary fatty amines; four fatty trimethyl ammonium chlorides, five difatty dimethyl ammonium chlorides, one trifatty methyl ammonium chloride, and two quaternized fatty diamines.

The new chemicals are versatile chemical intermediates possessing properties such as solubility in a wide variety of polar and nonpolar solvents, surface activity, base exchange, and anti-static activity. The fatty nitrogen chemical family is used extensively in the petroleum, mining, pharmaceutical, rubber, textile and coatings industries.—**General Mills, Kankakee, Ill. 80B**

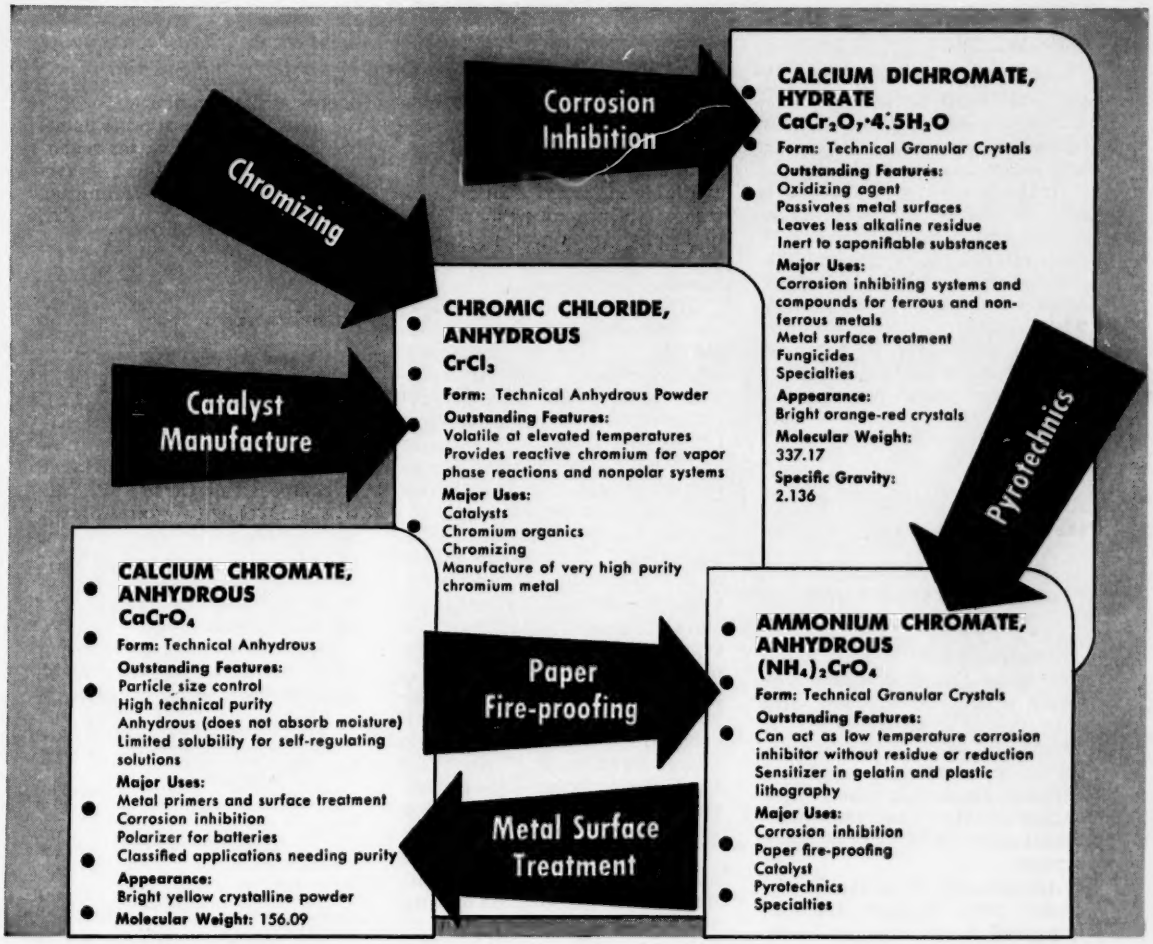
### Liquid $SO_3$

**Now properly stabilized, it offers economies as sulfonation agent.**

Liquid sulfur trioxide is now available in drums, tank trucks and tank cars from Grasselli, N. J.

Properly stabilized, liquid sulfur trioxide offers economic advantages in lower purchase and freight costs per pound of active ingredient. It eliminates spent acid separation and disposal problems. In addition, faster reaction rates and increased yields are often possible.

The new stabilizer provides additional handling tolerance by maintaining the sulfur trioxide in its low melting form. If solidification does take place,




# 4 DEVELOPMENTAL MUTUAL CHROMIUM CHEMICALS

## . . . to what new uses do they point for you?

As America's foremost producer of chromium chemicals for industry, Mutual is continually developing new and better products to meet specialized needs. Four of the most promising (out of more than a hundred developmental chemicals currently being investigated) are calcium chromate, calcium dichromate, ammonium chromate, and chromic chloride. Their properties may suggest applications to your problems, which we can help you explore. Sample quantities of these Mutual® products are available for investigation.

Want further information? Just mail the coupon.

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Please send samples and complete information on:

- ☐ Calcium Chromate, Anhydrous
- ☐ Calcium Dichromate, Hydrate
- ☐ Ammonium Chromate, Anhydrous
- ☐ Chromic Chloride, Anhydrous

Name _____

Position _____

Company _____

Phone _____

Address _____

City _____ Zone _____ State _____

the stabilized sulfur trioxide can be re-melted at about room temperature, making it easier and safer to work with.

Primary uses of the product are in the synthesis of high strength surface-active agents, dye intermediates insecticide emulsifiers, and lubricating oil additives, where compounds with higher molecular weights can be sulfonated to produce desirable oil-soluble sulfonates. **—Du Pont Co., Wilmington, Del.** **80C**

## Octylene Oxide

**Used as a diluent, it improves workability of epoxy resins.**

Octylene oxide is now being offered as a reactive diluent for epoxy resins. A low viscosity chemical (2.5 cps. at 25 C.), it effectively reduces the viscosity of conventional bisphenol A-based resins. It reacts with curing agents to become an integral part of the cured resin system.

Advantages of a lower viscosity resin system include: Improved workability and handling characteristics; more complete filling of voids in intricate casting operations; higher solid loadings; better wetting of reinforcing materials and other surfaces; better impregnation of porous materials; lower exotherm during cure, permitting larger castings; increased pot life.—**Food Machinery & Chemical Corp., New York.** **82A**

## Nonionic Cellulosic

**Promising as a stabilizer and thickener in many of the process industries.**

Development work on a newly available nonionic water-soluble hydroxyethyl ether of cellulose suggests its application as a stabilizer and thickener in water-based emulsion paints, preparation of polyvinyl acetate emulsions, textile warp and finish sizes, paper coatings and paper sizings, ceramics, inks and latex emulsions for adhesives and coatings.

Called Natrosol 250, it is now available in four viscosity types. One of its unique properties is that one viscosity type is the highest available nonionic cellulosic.

Other outstanding advantages of Natrosol 250 include its ability to produce unusually clear, smooth, sparkling solutions with no haze or color, and its availability in granular form in order to minimize dusting and lumping during handling as well as to improve dispersibility upon addition to water.

The highest viscosity type possesses a viscosity in excess of 20,000 cps. at 2% concentration. This material is useful for thickening and stabilizing all types of aqueous systems, and is relatively unaffected by the presence of salts, acids or alkalis in solution. Excellent compatibility with gums and latices renders it a preferred thickener in water-based emulsion paints and latex emulsions for adhesives and coatings.

The low-viscosity types are used as polymerization stabilizers in the preparation of vinyl acetate homopolymers and copolymers. The excellent low-temperature burnout properties of this derivative make it a useful binder for ceramic colors, glazes and refractory compositions. Ready insolubilization by resins and other reagents give it potential use in the fields of water-soluble printing inks and other water-resistant films and coatings. — **Hercules Powder Co., Wilmington, Del.** **82B**

## Fumigant

**Used on grain, it excels in effectiveness, safety and low costs.**

A liquid grain fumigant now being produced and marketed is composed of three 100% active ingredients — chloroform, carbon bisulfide and ethylene dibromide. They're said to form a mixture much more effective than the individual chemicals by themselves.

Typical of the data accumulated during a four-year development and testing program:

| | Chemicals by Volume | Min. for 99% Kill |
|---|---|---|
| Formula A | | |
| Carbon tetrachloride | 80% | |
| Carbon bisulfide | 15% | 100 units |
| Ethylene dibromide | 5% | |
| Formula B | | |
| Carbon tetrachloride | 66.5% | |
| Carbon bisulfide | 28.5% | 89 units |
| Ethylene dibromide | 5.0% | |
| Carbon Bisulfide | | |
| Carbon bisulfide | 100% | 75 units |
| Clorofume Formula | | |
| Chloroform | 71.25% | |
| Carbon bisulfide | 23.75% | 34 units |
| Ethylene dibromide | 5.00% | |

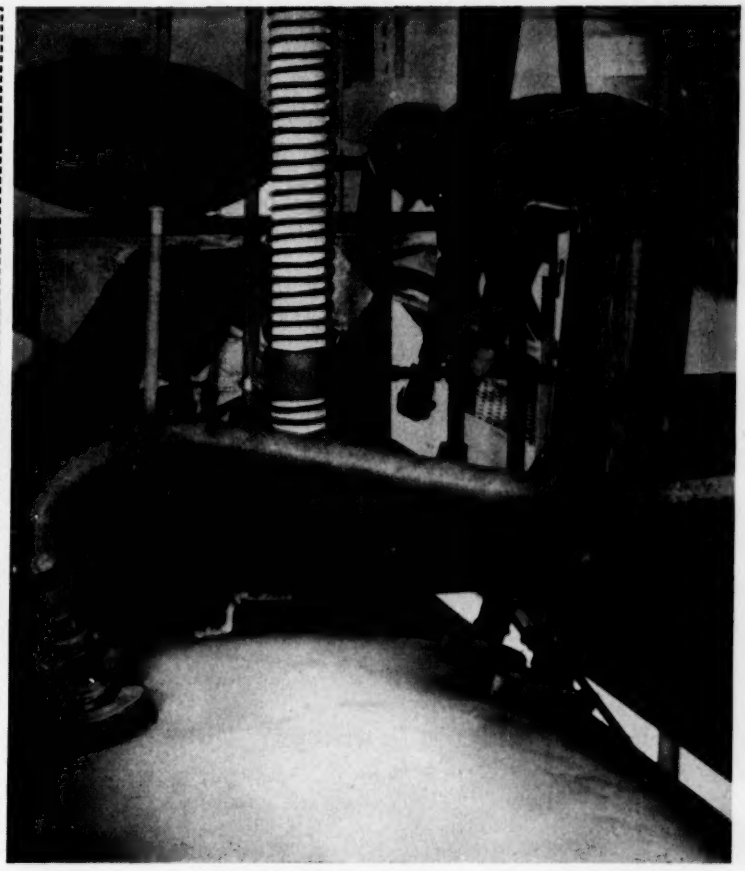
Testing of the new fumigant has demonstrated the following: high insect toxicity, killing at half normal dosage; greater grain penetrating power; sav-

## Newsworthy Chemicals

**Page Number is also Reader Service Code Number**


**Plastisol** molds copy carving ..... 80A
**Fatty nitrogen** chemicals come in 24 new varieties ..... 80B
**Liquid $SO_2$** gains stability ..... 80C
**Octylene oxide** improves epoxy resin workability ..... 82A
**Nonionic cellulosic** bids for wide stabilizer, thickener use. 82B
**Fumigant** for grain excels in effectiveness, safety ..... 82C
**P-Br treatment** ups wood's flame resistance ..... 84A
**Hydraulic fluid** resists fire at 2,000 psi., 150 F ..... 84B
**Hydraulic fluid** guards against fire in mine machinery .... 84C


**For more details, use Reader Service Card**



*In barrels or bulk . . .*

# YOU CAN HANDLE SODIUM SAFELY

Chemical process plants are now handling hundreds of tons of sodium every day . . . putting this reactive chemical to work in scores of processes. And as use grows, operating personnel are demonstrating that you can handle metallic sodium as safely as most other industrial chemicals by following recommended procedures.

The form in which sodium is bought and used varies with individual requirements. Whether you need bricks of any particular size, cast solid sodium in drums or pails, or bulk shipments in tank cars, U.S.I. can supply the sodium—and technical assistance to insure satisfactory, safe plant operations.

Our technical staff is equipped to help you with any aspect of sodium use . . . from the arrival of a shipment at your plant to clean-up of equipment and disposal of sodium residues. We can assist with as routine a problem as the safest way to cut a sodium brick, or show you our recommended procedure for unloading a tank car of molten sodium as safely as if it were caustic soda.

### Showcase for Sodium Handling

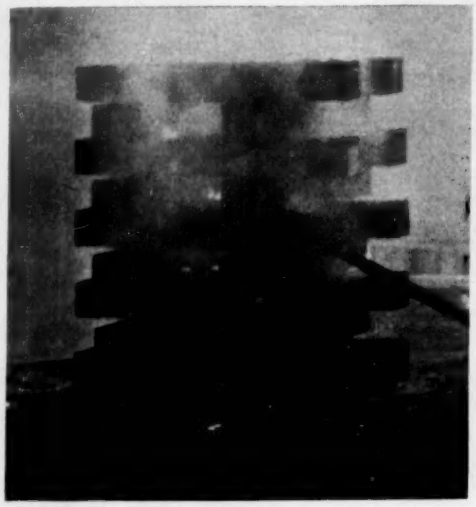
At the zirconium plant of Mallory-Sharon Metals in Ashtabula, Ohio, for example, U.S.I. know-how is used in a model installation for receiving, pumping, filtering and storing bulk shipments of sodium. Here, a few million pounds a year of metallic sodium—in 80,000-pound chunks—are melted and transferred from tank car to storage without contaminating the metal or bringing it in contact with outside material.

### Other Sodium Forms

If you require more reactive forms of sodium, U.S.I. can help you there, too. We can advise on the preparation of sodium sand, high surface sodium and sodium dispersions, and their use in your plant.

Write for our brochures, "Handling Metallic Sodium on a Plant Scale," "High Surface Sodium" and "Sodium Dispersions." For assistance on specific problems, contact our Technical Service Department.

**USI INDUSTRIAL CHEMICALS CO.**
Division of National Distillers and Chemical Corp.
99 Park Ave., New York, 16, N. Y.
*Branches in principal cities*



TREATED

UNTREATED

## Flames Die Just After Birth in P-Br-Treated Wood

**Ignited minutes ago, oiled wood crib at left stands intact and flame free as a result of treatment with P and Br compounds. Over an hour after ignition, untreated crib is in shambles, still burning.**

**Research into fire hazard created by oil-type preservatives in railroad trestles indicates a phosphorus-halogen mixture added in proper ratio as the most effective treatment.**

**Phosphorus as triaryl phosphate was found to contribute materially to reduction of the fire hazard. Halogen specifically reduces flame spread, thus contributing to reduction of the over-all hazard. Pentachlorophenol and 2,4,6-tribromoaniline appear to have properties that make them suitable as halogen carriers for this application.—Dow Chemical Co., Midland, Mich.** 84A

ings of 20-30% per bushel of protected grain; safe handling, required no special equipment or extraordinary precautions; offers no health hazard to human life when used with reasonable care and is approved by the Food & Drug Administration without restrictive use recommendations or residual tolerance limits.—**The Vulcan Materials Co., Birmingham, Ala.** 82C

## BRIEFS

**Hydraulic fluid** is aimed at fire-resistant service at pressures up to 2,000 psi. and operating temperatures up to 150 F. Formulated from specially refined, high-quality base oil, it forms a stable water-in-oil emulsion. Called Sunsafe, it not only resists thermal breakdown but, in the event of a break or rupture of the hydraulic system in the presence of flame or incandescent particles, it will not flash or support combustion.—**Sun Oil Co., Philadelphia.** 84B

**Hydraulic fluid** that is fire resistant has been developed for mining machinery as a replacement for mineral oil. Called 3XF Mine Fluid Emulsion, it is supplied as an oil concentrate which is mixed with drinking water on the job. On exposure to open flame, high-voltage arcs or hot metal, the fluid's water content is immediately released as a steam blanket to quench any source of combustion.—**Shell Oil Co., New York.** 84C

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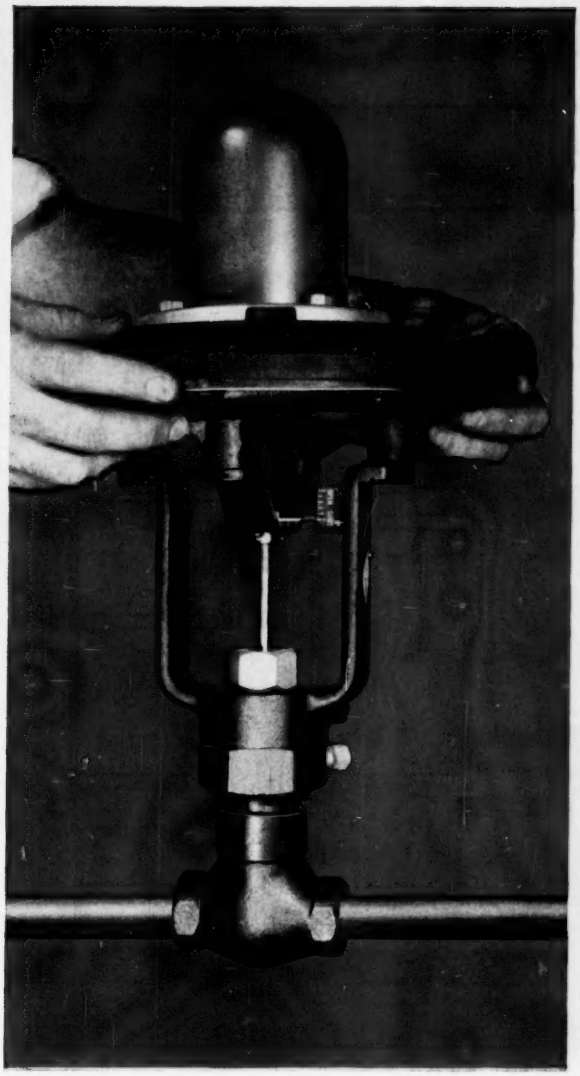
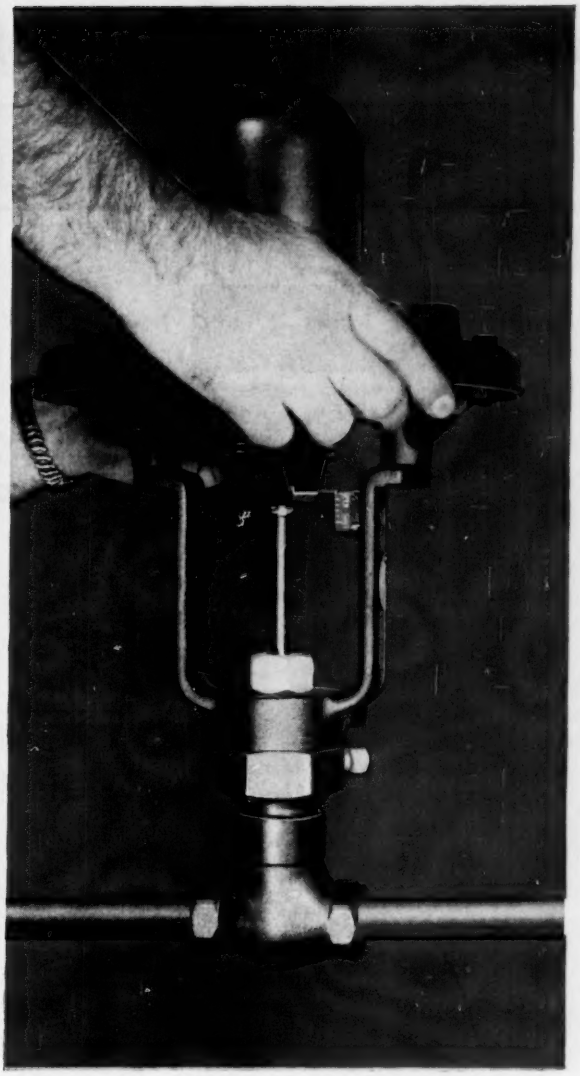




# LOOK HOW EASY IT IS TO REVERSE THE ACTION OF A FOXBORO CONTROL VALVE!

## air-to-open . . . air-to-close — one valve for the job of two

Unbolt the motor casing and rotate it 90°; rebolt and shift air connections — that's all you do to reverse the operation of a Foxboro control valve. Takes just a few minutes — without touching valve body or process piping — without employing special tools or skills.

Foxboro reversible motors are especially suited for needle valves, Saunders-type valves, and other control valves having non-reversible bodies. They're also used with Foxboro Stabilflo* Valves — the original valves with equal percentage flow characteristics and wide 50 to 1 rangeability.

Foxboro control valves with their quick-reversible valve motor, are an exclusive Foxboro development. They're perfect for pilot plant operations and other processes frequently "juggled." Types and materials to meet any process requirement.

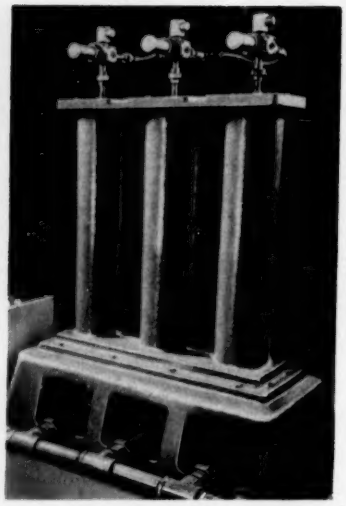
Write for detailed bulletins today. **The Foxboro Company, 368 Neponset Ave., Foxboro, Mass.**

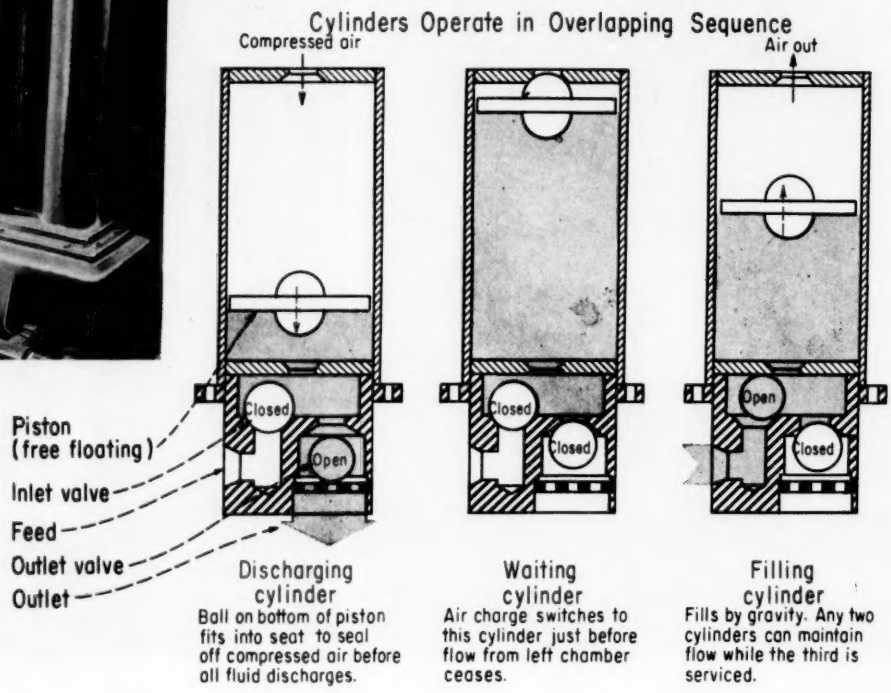
*Reg. U.S. Pat. Off.

FOXBORO

REG. U.S. PAT. OFF.

**Foxboro urges you to attend the I.S.A. Show in Chicago, Sept. 21-25**






# Air Drives Novel Free-Piston Pump

**Handling abrasive slurries or corrosive materials? Want to eliminate packings? Cut down on noise? New pump may help you.**

An old idea, some clever design plus 18 months of development may turn the tables on many irksome pumping problems. With introduction of Crossley Machine's free-piston pump, engineers have at their disposal a specialty equipment item that needs no motor, no gearing, no safety valves, no seals nor packings.

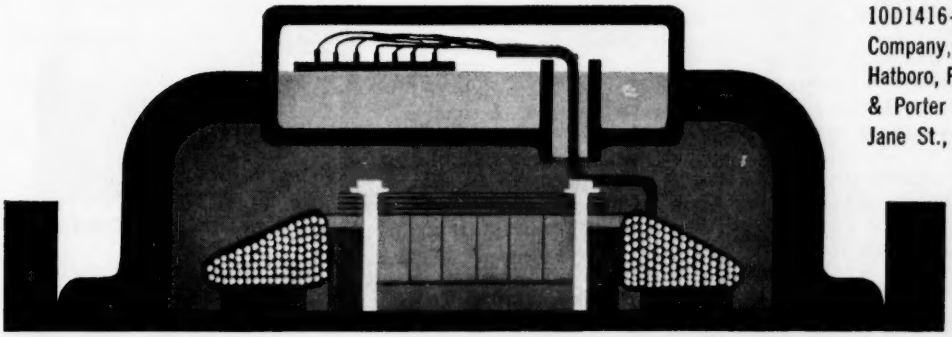
Lubrication is unnecessary. The pump is noiseless, vibrationless, and will move anything that flows, without pulsation. Required maintenance is small, and for sanitary service, the unit dismantles readily for cleaning.

▶ **Air Is Motive Force**—Principle of operation is quite simple. Each of three chambers fills by

# new F&P magnetic flowmeter 200 times more sensitive

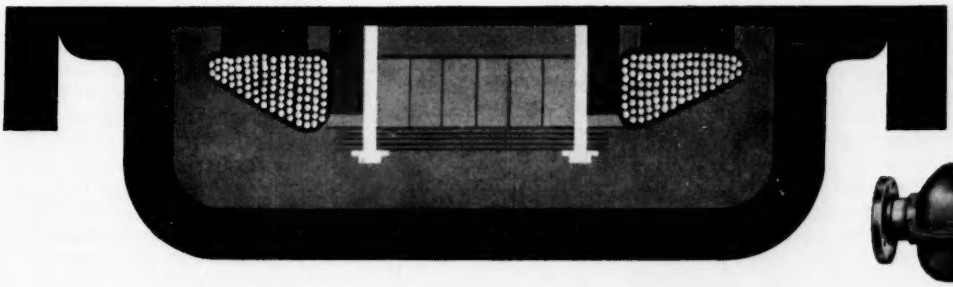
Low-conductivity liquids meet their master in F&P's new magnetic flowmetering system. In one big technological jump, this new magnetic meter leaves all others behind . . . metering liquids and slurries with conductivities as low as 0.1 micromho per cm. Completely free of all obstructions, this versatile instrument provides accuracies better than ±1% of flow—independent of viscosity, density, turbulence, or changes in liquid conductivity.

Get all the facts on the world's most versatile flowmeter —the F&P Magnetic Flowmeter. Contact the F&P field engineer nearest you, or write for Catalog 10D1416-1. Fischer & Porter Company, 189 County Line Road, Hatboro, Pa. In Canada, Fischer & Porter (Canada) Ltd., 2700 Jane St., Downsview, Ontario.



ACETALDEHYDE • ANHYDROUS AMMONIA • BENZYL ALCOHOL • DISTILLED WATER • FORMIC ACID

HYDROGEN CYANIDE • ISOPROPYL ALCOHOL • LIQUID PHOSPHORUS • O-TOLUIDINE • SULFONIC ACID • URIC ACID



**FP**

**FISCHER & PORTER COMPANY**

COMPLETE PROCESS INSTRUMENTATION

gravity with feed liquid and then empties in overlapping sequence under the force of compressed air. Air charge, separated from the liquid by floating pistons, is automatically switched from one chamber to another by a timing-control system that assures the uninterrupted air-free liquid flow. (See schematic illustration on preceding page.)

Capacity is limited only by pump size. A 100-gpm. unit has dimensions of 45x24x53 in.; smallest standard size is 5 gpm. Discharge pressure depends solely on available air pressure and strength of construction materials. For example, with a 100-psi. air input, the unit will pump water against about a 200-ft. head.

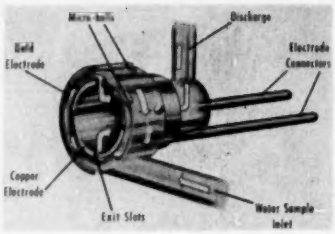
▶**Crystal Gazing** — As yet, Crossley's pump has not had a chance to prove itself in full-time service within the process industries. However, a test prototype has shown its ability to handle materials ranging from ceramic slip to penicillin mold. And according to company officials, a unit will soon be given a chance to prove its worth pumping molten aluminum.

Prospects are that free-piston pumps will fill the bill in many applications where abrasion-resistance is a process requirement and corrosion, foaming, cavitation or plugging are frequent stumbling blocks.

In some cases, a limitation to efficient utilization may arise from the pump's inability to operate without positive feed. Either an elevated feed tank must be installed, the pump must be submersed in the feed source, or the chambers' discharge air must be applied as a liquid-lifting medium.

▶**Cost and Materials**—Construction materials for chamber bodies and liners are varied to meet specific process requirements. Pistons and check-valve balls are also offered in a range of materials, with nylon leading the list.

Prices vary accordingly. As a guide, a 100-gpm. unit of stainless steel and nylon construction will run about $2,000. —**The Crossley Machine Co., Trenton, N. J.** **86A**




## Analyzer

**Self-cleaning electrodes up analysis accuracy.**

Under license agreement with the German firm Chlorator, G.m.b.H., Fischer & Porter is currently manufacturing and marketing a new residual chlorine analyzer. Known as the Depolox, the analyzer may be used alone for regulating chlorine addition according to residual. Or it may find use in combination with flow rate control equipment in a completely automatic closed-loop system.

One feature of Depolox is incorporation of Micro-Ball self-cleaning electrodes. A number of extremely small glass balls circulate across the surfaces of electrodes to keep them clean. Clean electrodes assure accurate readings. Electrode assembly is claimed to have three to four times the life of ordinary, smaller assemblies.—**Fischer & Porter Co., Hatboro, Pa.** **88A**

## Chart Changer

**Fits all standard circular chart recorders.**

Automatic Meterman, a new timesaver for operating personnel, automatically changes and stores as many as 40 circular charts for any standard recording device. It disengages the charts, one by one, at virtually any desired time/date frequency, and drops them by gravity into a self-contained storage box.

With Meterman, a large number of field or plant recorders can be serviced at the same moment without manual attention, thus making it possible to correlate all charts with master meter records without multiple computations. The equipment fits all standard recorders using circular charts of any diameter or thickness. It uses only a tiny portion of available clock power.—**Maeder-Squier Co., Dallas, Tex.** **88B**

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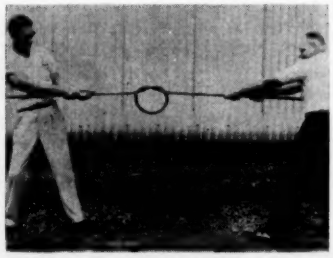


## Heat Exchanger Tubing

**Weld flash removed during product fabrication.**

Welded steel tubing designed for heat-exchanger applications has proved equal or superior to seamless carbon steel tubing, according to the manufacturer. Bearing the trade name Lectrosonic, the new product claims uniform strength, dimensions and properties, and is easily workable and less costly than seamless tubing. Prices show savings ranging from 10 to 32% over materials it is designed to replace.

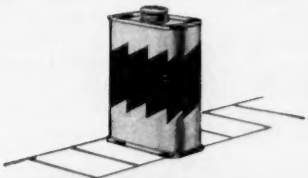
Removal of the weld flash, or bead, from the entire tube length during fabrication improves corrosion resistance and flow properties. It also permits quick alteration of tube length in the field, eliminating the need for flash removal by the user.

All tubing meets ASTM Specifications A-214 and A-334, Grade C, and identical ASME specifications. Sizes range to

# Continental "F" style cans make displays that sell

## Easy stacking

"F" style cans have a recessed bottom that fits securely on top of can below. Floor and counter displays stay attractive no matter how high you stack them.

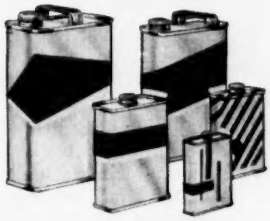


## Save shelf space

Oblong "F" style cans fit together snugly without lost space per shelf foot, get greater emphasis on *your* product. It's easy to create mass displays that create impulse sales with "F" style cans.

## Superb lithography

Continental's excellent lithography gives your product sparkling sales appeal. Broad can surface allows more display space for a powerful sales message.



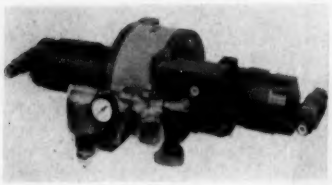
## Sizes to fit

Displays pay off when the customer sees what he wants. Continental "F" style cans are available in five convenient sizes ranging from eight ounces to one gallon.

**CONTINENTAL CAN COMPANY**

Eastern Division: 100 East 42nd Street, New York 17
Central Division: 135 South La Salle Street, Chicago 3
Pacific Division: Russ Building, San Francisco 4
Canadian Division: 5595 Pare Street, Montreal, Que.

4½ in. O.D. in all normally required standard wall thicknesses.—**Babcock & Wilcox Co., Tubular Products Div., Alliance, Ohio.** 88C



## Air-Operated Pumps

**Smooth-operating units develop 50,000 psi.**

Ideal for locations where electrical power is not available or where such power is dangerous to use, a new line of air-powered pumps develops liquid pressures to 50,000 psi. at temperatures to 500 F.

In operation, one piston of the duplex pump provides suction, while the other delivers the high-pressure fluids. Small clearance volume on discharge results in more efficient pumping, especially when compressibility is an important consideration.

There is no conventional crank-arm action—an automatic, air-transfer valve reverses air flow from one side of the drive piston to the other, thus maintaining continuous liquid flow. Check valve assemblies are external and easily accessible for maintenance or replacement. Required air pressure is 100 psi. Packings vary with application.—**American Instrument Co. Inc., Silver Spring, Md.** 90A

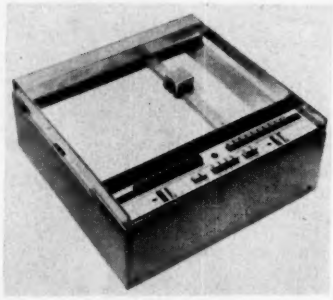
## Pipeline Data System

**Produces digital record of pipeline variables.**

Accurate measurement, transmission, indication and recording of flow, pressure, temperature and other pipeline variables in digital form is the function of the new Pipeline Information System.

In operation, the low-cost system measures variables at remote points and relays data by means of standard communication or telemetering equipment to a central control station. There, data are converted into digital form and recorded by automatic typewriter. Core of the system is a single transistorized analog-to-digital converter.

Also featured is a continuous alarm monitor with adjustable high-low set points. Measured data are indicated directly in psi., deg. F. or C., rpm., bpm. or in any other convenient units of measurement.—**Fischer & Porter Co., Hatboro, Pa.** 90B



## X-Y Plotter

**Has high static and dynamic accuracies.**

Among the features of a new pushbutton-operated X-Y plotter are vernier scale ranges, high accuracy and ease of operation. A flat vacuum platen and provision for precision positioning facilitate paper alignment and loading.

Called Model 210, the plotter claims a static accuracy of ±0.1% of full scale, and a dynamic accuracy of ±0.2% of full scale at 10 in./sec. tracing speed. Both control panel and plotting table are adaptable to 19-in. rack mountings as well as to standard table units.

Model 210 accommodates a full range of accessory equipment, including decimal keyboard, X-axis time drive, punched-card and punched-tape conversion equipment, curve follower, point joiner and multiple-symbol printing head. —**Librascope, Inc., Glendale, Calif.** 90C

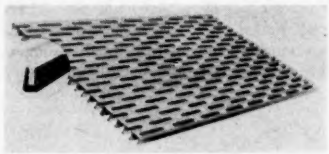
## Synchronous Motor

**Low-speed unit requires no gear reduction.**

With 60-cycle input, speed of the new Slo-Syn enclosed synchronous motor adjusts to 72 rpm. without gear reduction. Torque is conservatively rated at 150 oz.-in. A single-pole, three-position switch gives instant starting, stopping and reversing control—no accessory starting and electrical or mechanical braking equipment is needed.

Slo-Syn adapts to a wide variety of applications, ranging from remote control to numerical control systems. When used as a stepping or inching motor, d.c. impulses are converted into either 200 or 400 precise increments of one revolution of the motor shaft.

Rated input is 120 v., 40/70 cycles, single-phase. Current at 60 cycles is 0.3 amp. maximum. Motor diameter is 4¼ in.; depth is 4¾ in.—**The Superior Electric Co., Bristol, Conn.** 90D

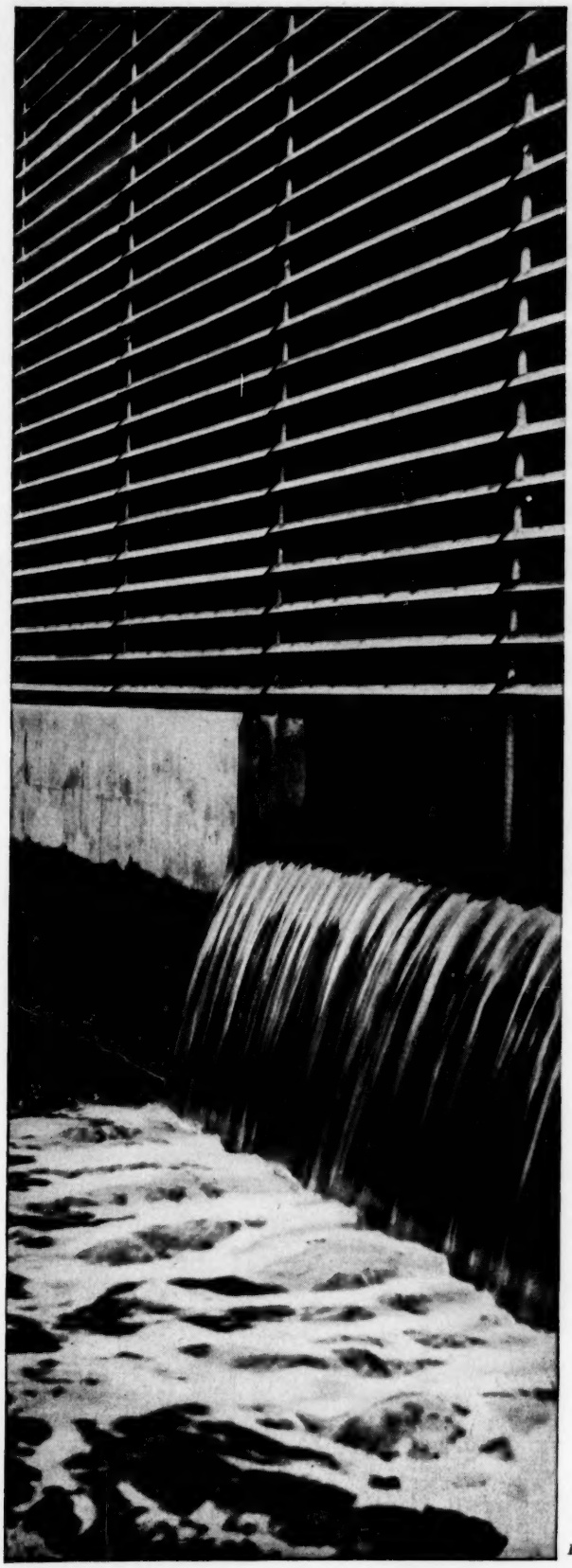


## Aluminum Grating

**Locking clip simplifies field installation.**

Foremost feature of a new, lightweight, high-strength, extruded aluminum grating is an exclusive snap-lock method of field assembly that eliminates need for welding. To fasten adjacent sections, merely position an aluminum clip and hammer it into place. The clip ties together interlocking I-beams on the mating edge of each section, and remains under tension

EQUIPMENT NEWS Continues on . . . Page 176



# Wanted! 215,000,000,000 gallons of water per day!

**Your process cooling towers** may be doing a fulltime job now, but soon you'll have to work them overtime. By 1975, report authorities, industry *alone* will require 215,000,000,000 gallons of water per day!

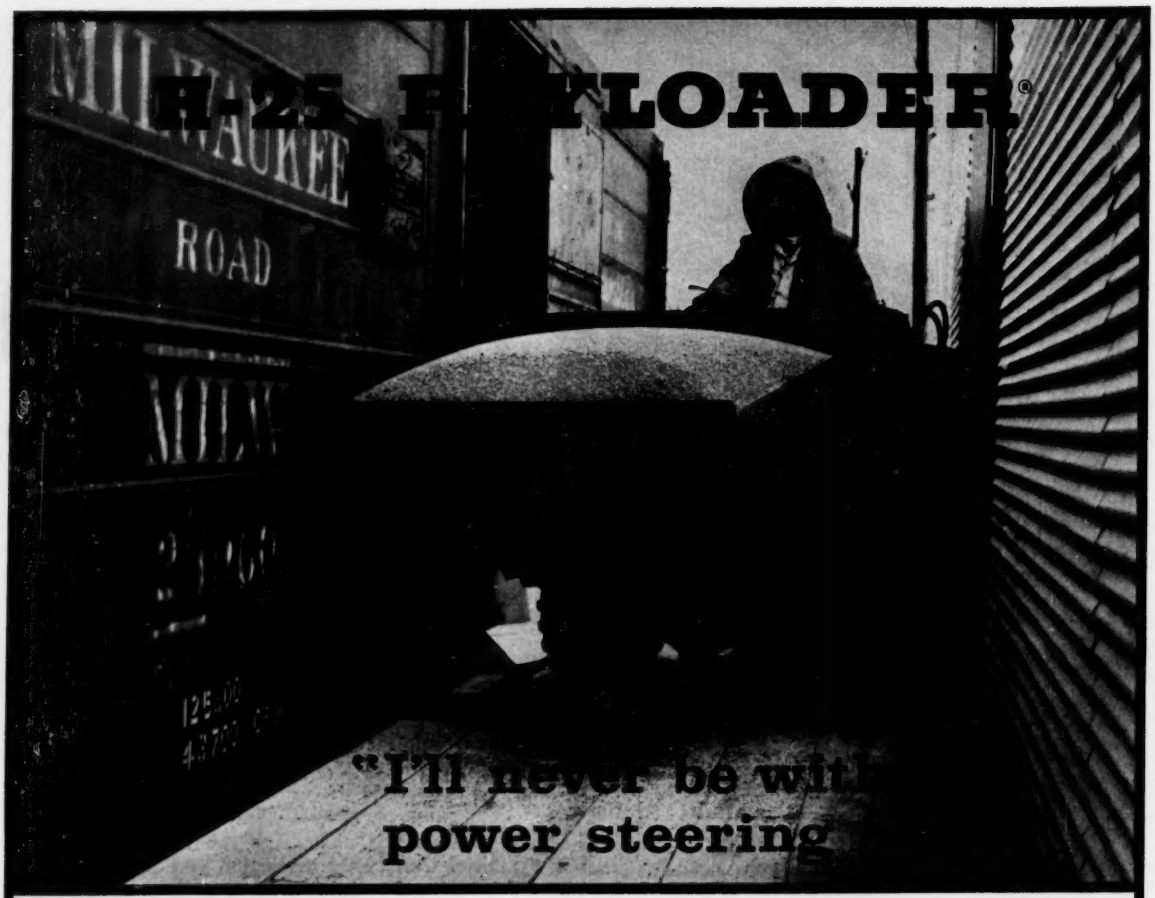
To stand up to such intensive usage, towers should have the protection that only continuous L&N pH control automatically provides. L&N engineers treat each tower as an individual pH problem. Its control system is engineered on the basis of L&N's pH Controllability Analysis. This appraisal of the tower's "controllability factors" (flows, retentions, concentrations, etc.) tells us whether pH is actually controllable under existing tower conditions. If the answer is negative, the analysis highlights what must be done to *make* pH controllable.

The benefits of this unique L&N approach are significant. They include, in the words of an operator of two 200,000-gallon towers, ". . . conserving large amounts of make-up water, wood protection, prevention of carbonate scale, and more effective slime control." His report adds that "automatic pH control at both plants has been effective and satisfactory."

Write for Process Data Sheet 700(1), "L&N pH Control of Cooling Tower Water." You'll also receive our Controllability Analysis Questionnaire to complete and return, without obligation, for answers to your cooling tower pH problems. The address, Leeds & Northrup Co., 4916 Stenton Ave., Phila. 44, Pa.

LEEDS Instruments NORTHRUP Automatic Controls • Furnaces

*Photo courtesy J. F. Pritchard Co.*




**"There's no exertion and lots more maneuverability with the power-steering. It's simpler, also faster loading and getting in and out,"** adds Roy Forman of Lee County Service Co. of Amboy, Ill.

Whether you are doing rail car unloading or any other kind of bulk handling, the power-steer and power-shift features of the Model H-25 "PAYLOADER" spell ease of operation and fast maneuvering that move more tonnage per shift.

This outstanding tractor-shovel also boasts the most thorough protection against dust and dirt — a triple air cleaner system, cartridge type oil filters on all three oil systems, and grease and oil seals at all strategic joints.

Other proven "PAYLOADER" models are also available, from 2,000 to 12,000 lbs. carry capacities, to meet your every material handling need. Your Hough Distributor is ready to serve you. See him today.

## Maneuverability and Speed . . .

**The H-25 with 2,500 lb. carry capacity, only 6 ft. turning radius and easy power steering, is the most concentrated package of tractor-shovel productivity ever designed. Power-shift transmission with two speeds forward *and* reverse, power-transfer "no-spin" differential, and 4,500 lbs. of bucket break-out force are other outstanding features that speed production and reduce operator effort..**

**THE FRANK G. HOUGH CO.**
754 Sunnyside Ave., Libertyville, Ill.

☐ Send full facts about the H-25 PAYLOADER ☐ Other PAYLOADER Models

Name _____

Title _____

Company _____

Street _____

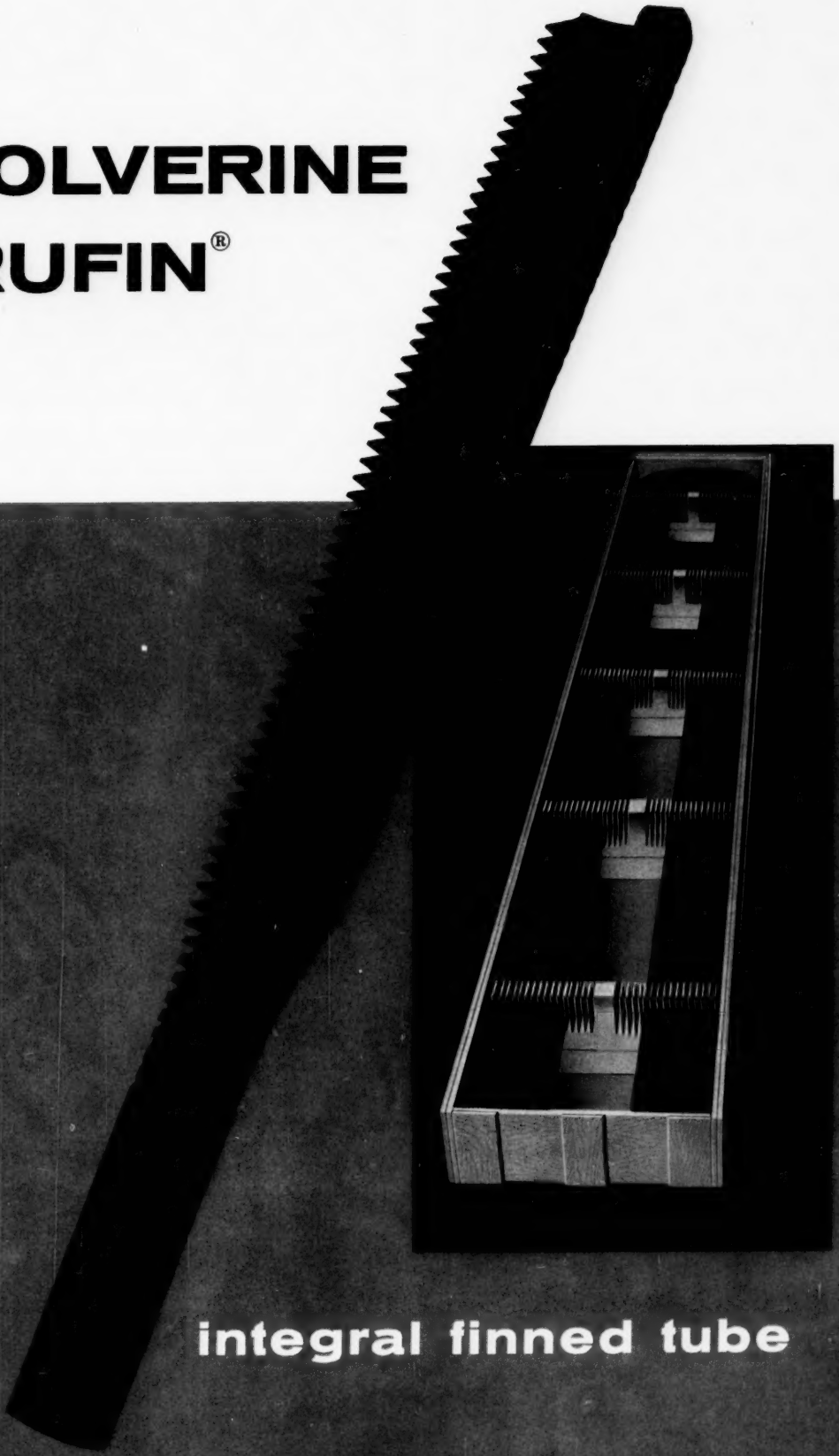
City _____ State _____

8-A-1

**HOUGH®**

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY — INTERNATIONAL HARVESTER COMPANY

# WOLVERINE TRUFIN®



the integral finned tube

## when EXPERIENCE counts

## —you can count on

# WOLVERINE TUBE

Wolverine Tube developed integrally finned tubing (Wolverine Trufin) in 1928 and since that time has been the originator of most of the available information on finned tube technology.

Wolverine research has uncovered the most advantageous applications of Trufin and has developed the various types of integrally finned tube on the market today.

For the past several years, throughout the country's major processing and refining areas, Wolverine has conducted a series of Technical Heat Transfer Seminars under the guidance of the top men in this field.

Wolverine Tube has also given special and extensive heat transfer and integrally-finned tube training to a number of Technical Sales Representatives who operate on a national basis. The services of these men are available to the heat transfer industry at large. Those desiring specific finned-tube knowledge can also draw on Wolverine's large library of product literature and catalogs.

There is an American business maxim that says *"For qualified guidance you must seek a qualified source."*

You'll find that where integrally-finned tubing is concerned Wolverine Tube is indeed such a source.

### WOLVERINE ALLOY CODE

| CODE NO. | ALLOY | WT./FT. CONVERSION FACTOR (Wt./Ft. of Copper x Conv. Factor= Wt./Ft. of alloy) |
|---|---|---|
| 01 | Copper | 1 |
| 25 | Admiralty (Type C) | .9531 |
| 26 | Admiralty (Types B & D) | .9531 |
| 28 | 85/15 Red Brass | .9780 |
| 30 | Aluminum Brass (Type B) | .9319 |
| 40 | 1100 Aluminum | .3032 |
| 41 | 3003 Aluminum | .3065 |
| 50 | Nickel | 1 |
| 51 | 70/30 Cupro-Nickel | 1 |
| 53 | 90/10 Cupro-Nickel | 1 |
| 54 | Monel | 1 |
| 60 | Low Carbon Steel | .8761 |
| 70 | Stainless Steel | .8978 |

**Example: *Wolverine Trufin type S/T***
***Catalog No. 60-195065-26***

| 60 | 19 | 5 | 065 | 26 |
|---|---|---|---|---|
| TYPE S/T | FINS PER INCH | ROOT DIA. IN 1/8 OF INCH | WALL AT FIN | ALLOY |

TRUFIN TYPE H/A

19 FINS PER INCH

| NOMINAL SIZE | CATALOG NO. | PLAIN SECTION DIMENSIONS | |
|---|---|---|---|
| O.D. | | O.D. | Wall Thk. |
| 5/8 | 60-194028 | .625 | .042 |
| | 60-194035 | | .049 |
| | 60-194042 | | .058 |
| | 60-194049 | | .065 |
| | 60-194065 | | .083 |
| 3/4 | 60-195028* | .750 | .049 |
| | 60-195035 | | .052 |
| | 60-195042 | | .058 |
| | 60-195049 | | .065 |
| | 60-195065 | | .083 |
| | 60-195083 | | .095 |
| 7/8 | 60-196035* | .875 | .054 |
| | 60-196042 | | .058 |
| | 60-196049 | | .065 |
| | 60-196065 | | .083 |
| | 60-196083 | | .095 |
| 1 | 60-197042 | 1.000 | .058 |
| | 60-197049 | | .065 |
| | 60-197065 | | .083 |
| | 60-197083 | | .095 |

TRUFIN TYPE L/C—BIMETAL

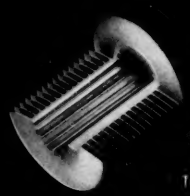
TRUFIN TYPE H/R

TRUFIN TYPE S/T

TRUFIN TYPE S/T—DUPLEX

| FINNED SECTION DIMENSIONS | | | | OUTSIDE AREA | SURFACE AREA RATIO | I.D. CROSS SECTIONAL AREA In Sq. Inches | APPROX. WT./FT. LBS. (Copper) | AVAILABLE ALLOYS (See Attached Code) |
|---|---|---|---|---|---|---|---|---|
| Root Dia. | Wall Thk. | Inside Dia. | $d_e$ | Sq. Ft. per Linear Ft. | ao/ai | | | |
| .500 | .028 | .444 | .535 | .405 | 3.48 | .155 | .283 | |
| | .035 | .430 | | | 3.60 | .145 | .320 | 01, 53, 40, 41, 50 |
| | .042 | .416 | | | 3.72 | .136 | .356 | |
| | .049 | .402 | | | 3.85 | .127 | .391 | |
| | .065 | .370 | | | 4.18 | .108 | .466 | 01, 53, 51, 40, 41, 50, 28, 25, 26, 60 |
| .625 | .028 | .569 | .660 | .496 | 3.33 | .254 | .353 | |
| | .035 | .555 | | | 3.41 | .242 | .401 | 01, 53, 40, 41, 50 |
| | .042 | .541 | | | 3.50 | .230 | .448 | |
| | .049 | .527 | | | 3.60 | .218 | .493 | |
| | .065 | .495 | | | 3.84 | .192 | .593 | 01, 53, 51, 40, 41, 50, 28, 25, 26, 60 |
| | .083 | .459 | | | 4.13 | .166 | .697 | |
| .750 | .035 | .680 | .785 | .588 | 3.30 | .363 | .485 | |
| | .042 | .666 | | | 3.37 | .349 | .541 | 01, 53, 40, 41, 50 |
| | .049 | .652 | | | 3.44 | .334 | .597 | |
| | .065 | .620 | | | 3.62 | .302 | .721 | |
| | .083 | .584 | | | 3.85 | .268 | .853 | 01, 53, 51, 40, 41, 50, 28, 25, 26, 60 |
| .875 | .042 | .791 | .910 | .678 | 3.27 | .492 | .632 | |
| | .049 | .777 | | | 3.33 | .474 | .699 | 01, 53, 40, 41, 50 |
| | .065 | .745 | | | 3.48 | .436 | .847 | |
| | .083 | .709 | | | 3.65 | .395 | 1.006 | 01, 53, 51, 40, 41, 50, 28, 25, 26, 60 |

*Plain lands are available on all standard Type S/T sizes except 195028 and 196035. All lands are supplied in the annealed condition. They are limited to a minimum length of one inch.



TRUFIN TYPE I/L

TRUFIN TYPE S/T
U-BEND FOR SHELL AND TUBE CONDENSERS

## NEED HELP WITH HEAT EXCHANGER PROBLEMS?

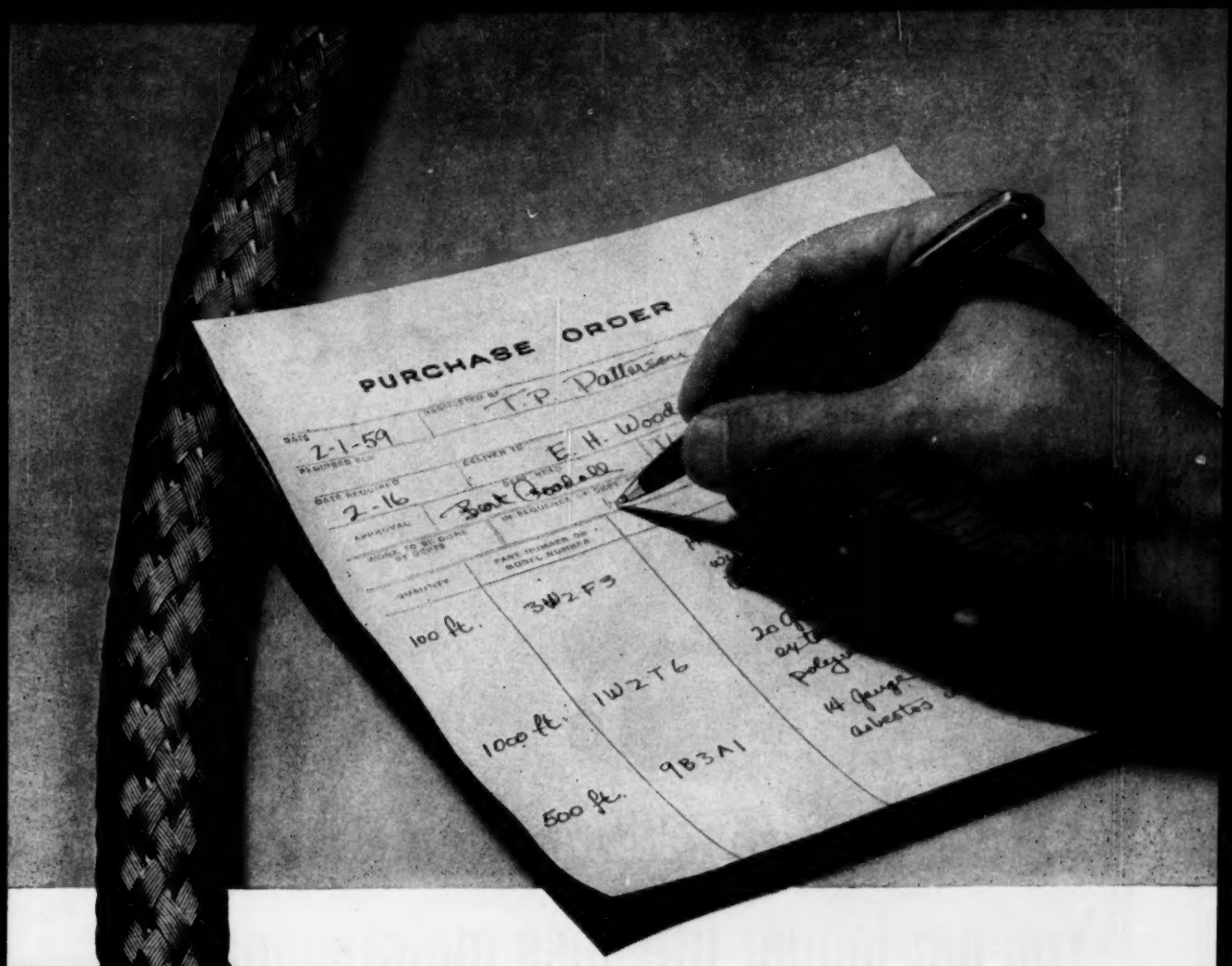
### Let These Specialists Serve You

Each of these men is a highly-trained specialist in the field of heat transfer. If you have a problem concerning such things as design, corrosion, alloy selection, where and when to use integrally-finned tube, etc.—don't hesitate—give the one nearest you a call. You can depend fully on his heat transfer knowledge.

WOLVERINE TU...

Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA




# Write your own ticket for Honeywell thermocouple wire

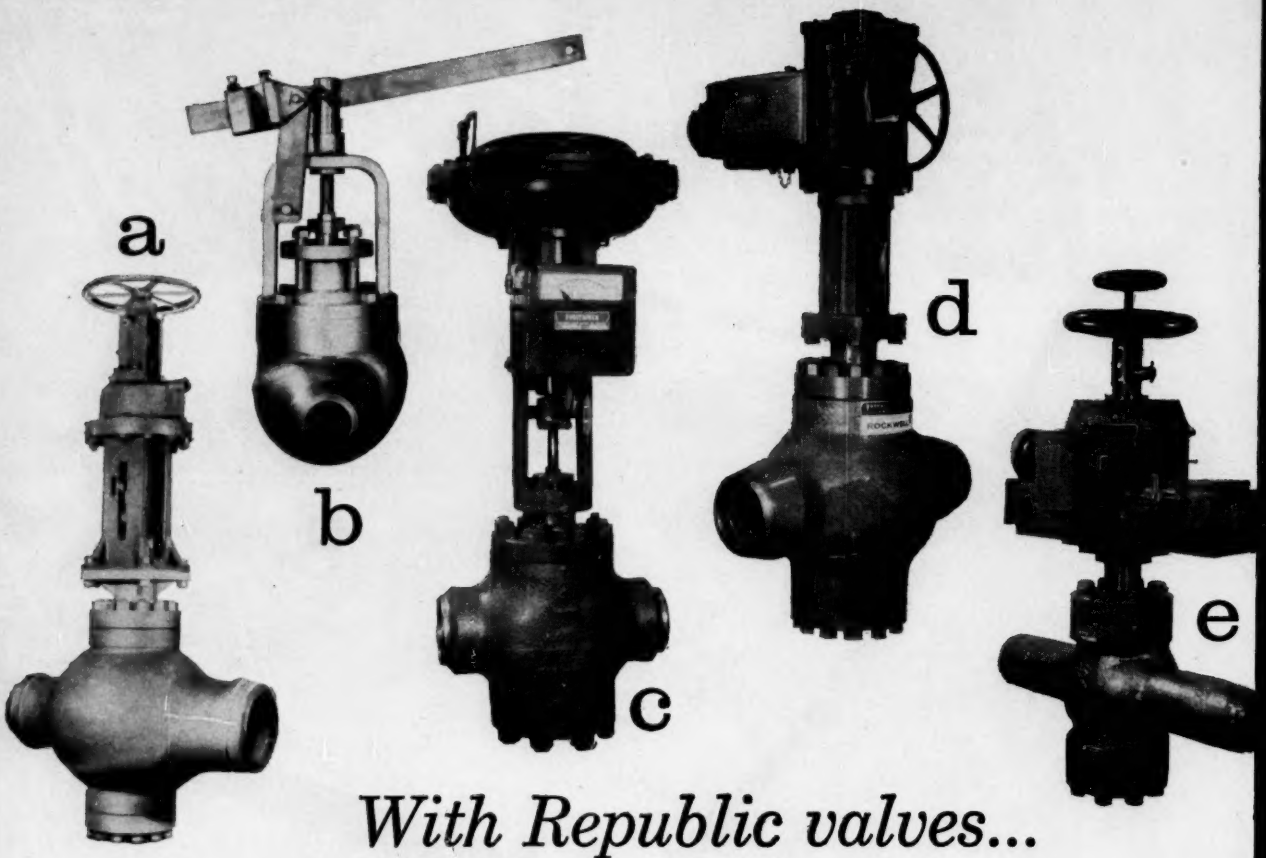
Choose from over 100 variations of insulated thermocouple wire and thermocouple extension wire. Honeywell can supply it from stock, with insulation in any of the conventional combinations of asbestos, glass, polyvinyl, Teflon and others. Should your application require other than conventional insulation, Honeywell can custom-make what you need, quickly and economically.

Call your local Honeywell field engineer . . . he's as near as your phone. Or write for Buyer's Guide C100-8.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

# Honeywell

First in Control




*With Republic valves...*

# You get longer life, less maintenance

For over 35 years Republic valve developments have paced the changing demands for more sturdy valves by the most progressive utilities and industries. For such services as pump recirculation control, feedwater regulation, steam pressure reducing and high pressure water control, Republic valves have established a reputation for durability, long life and trouble-free performance.

**Superior valve design**—Republic research into the causes of valve noise and vibration, and also the wear resisting and galling properties of materials has resulted in a modern line of Republic valves of advanced design. Republic valve contours are designed to produce not only the desired regulating characteristics but also to reduce erosion damage and noise as well. Extra large guide bushings, extra deep stuffing boxes, solid plug inner valve construction, plus precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance.

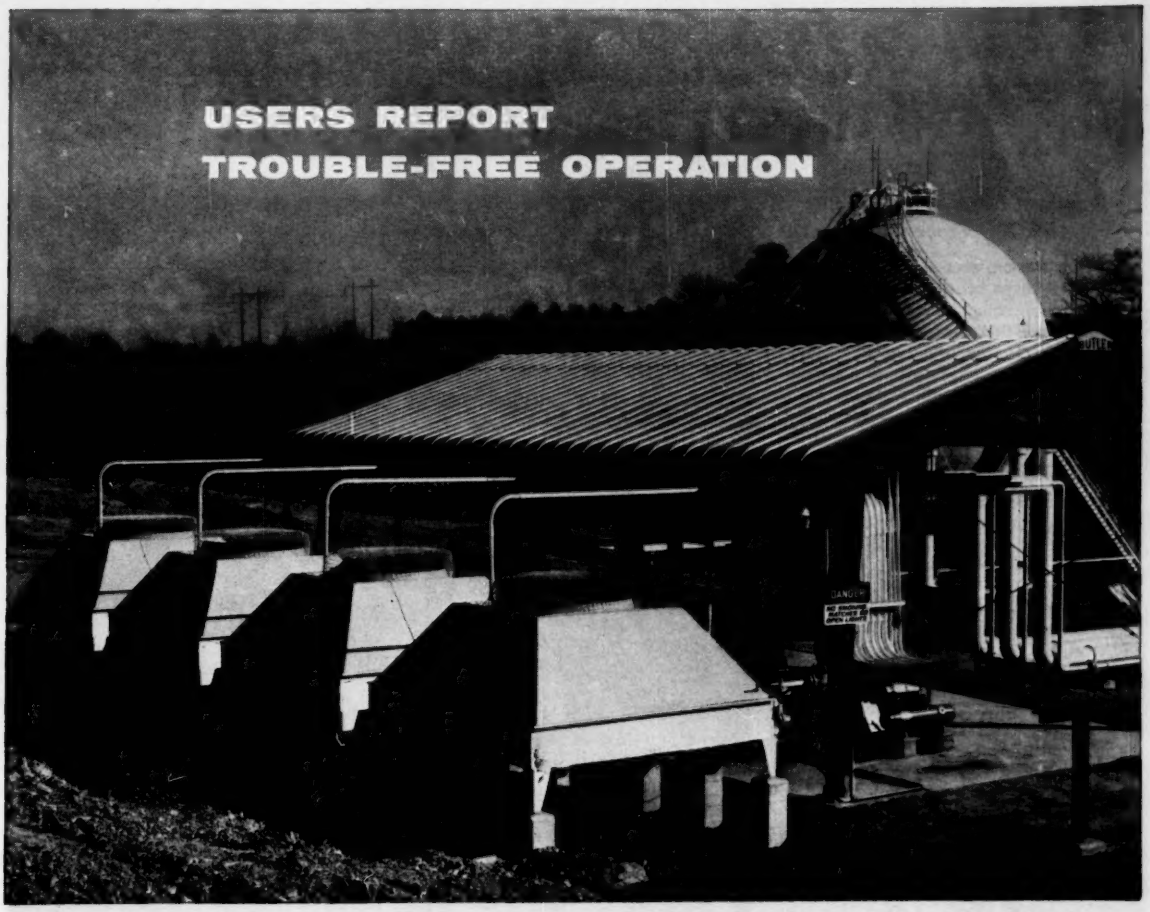
**Wide selection of valves and features**—Rockwell-built Republic regulating valves shown on this page are representative of the complete Republic line:

a. **Cylinder operated valve**
b. **Lever operated valve**
c. **Diaphragm operated valve**
d. **Motor operated valve**
e. **Toggle head operated valve**
f. **Diaphragm operated angle valve**

And, for many special applications, such Republic accessories as pneumatic and electric valve positioners for hysteresis-free control, and a complete line of controllers are available.

Whatever your regulating valve problem, let Republic engineers put their years of application experience to work for you. For additional information, see your Republic representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL




"Buffalo" Air Cooled Condensers Handling Propane Gas on Refrigerated Liquid Propane Storage Spheres. Photo—Courtesy of Rust Engineering Co.

# WITH NEW "BUFFALO" AIR COOLED CONDENSERS

Some time ago, "Buffalo" began field testing Air Cooled condensers and Air Cooled Liquid Coolers of completely new design. But we withheld the advertising of this unique product until we could talk in terms of a **field-proven** unit. Now, we can.

"Buffalo" Air Cooled Condensers have been installed on a wide variety of applications. Reports from actual users now prove their highly efficient and economical operation. They provide complete freedom from operating difficulties. Service requirements are reduced to an absolute minimum.

These field reports prove beyond all doubt that the new "Buffalo" units have eliminated the difficulties common to most air cooled condensers.

**Only "Buffalo" Air Cooled Condensers Bring You All These Advantages:**

**VERTICAL DISCHARGE**—is not affected by wind velocity—holds compressor on line.

**EASY-TO-INSTALL**—shipped as factory-assembled packages. Lifting eyebolts simplify rigging.

**LOW SILHOUETTE**—the No. 1000 unit is only 76" high.

**OPPOSED BLADE BY-PASS DAMPER CONTROL AVAILABLE**—provides close modulating control not possible with parallel-blade dampers—or with "flooded coil control". Saves expensive refrigerant.

**UNIT CASINGS**—heavy-gauge galvanized steel construction insures durability, long life.

**AMPLE CAPACITIES**—Standard sizes from 7½ to 100 tons based on 120° condensing temp. 40° suction, 100° ambient. Larger sizes for special refrigerant, liquid or gas cooling applications available as factory-assembled packages.

**Applications of "Buffalo" Air Cooled Condensers** include air conditioning and steam condensing . . . also jacket water cooling of diesels, package compressors, gas turbines, electronic tubes, power transformers, process liquids, heat pumps.

For the utmost in reliable performance, new "Buffalo" Air Cooled Condensers are your best choice. Call your nearby "Buffalo" engineering representative for complete facts. Or write us direct.

"Buffalo"

**BUFFALO FORGE COMPANY** Buffalo, N. Y.

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

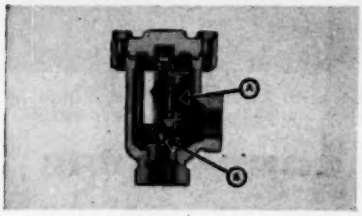
VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

# Full-range steam traps cut high cost of steam pressure variations

*By John W. Ritter, Test Engineer*
*SARCO Company, Inc.*

While boiler room economics dictate that boiler pressures remain constant, the equally sound economics of batch processing may decree that pressures at the equipment vary with the requirement of the process. The attempt to choose a steam trap that is all things to all conditions may result in installing traps that operate inefficiently at either extreme of their pressure range or that require adjustment every time the operations sheet calls for another pressure-temperature setting. Orifice traps represent a somewhat more rational approach to the problem, but often at the price of a continuous discharge of steam, particularly at the low pressures of start-up and shut down. Compromise, adjustment, and steam waste all spell inefficiency in the utilization of steam.

**Production-Planned** steam trapping, on the other hand, improves efficiency by the use of properly designed and installed thermostatic steam traps. Such traps employ the expansion and contraction of a thermostatic element to operate the discharge valve.

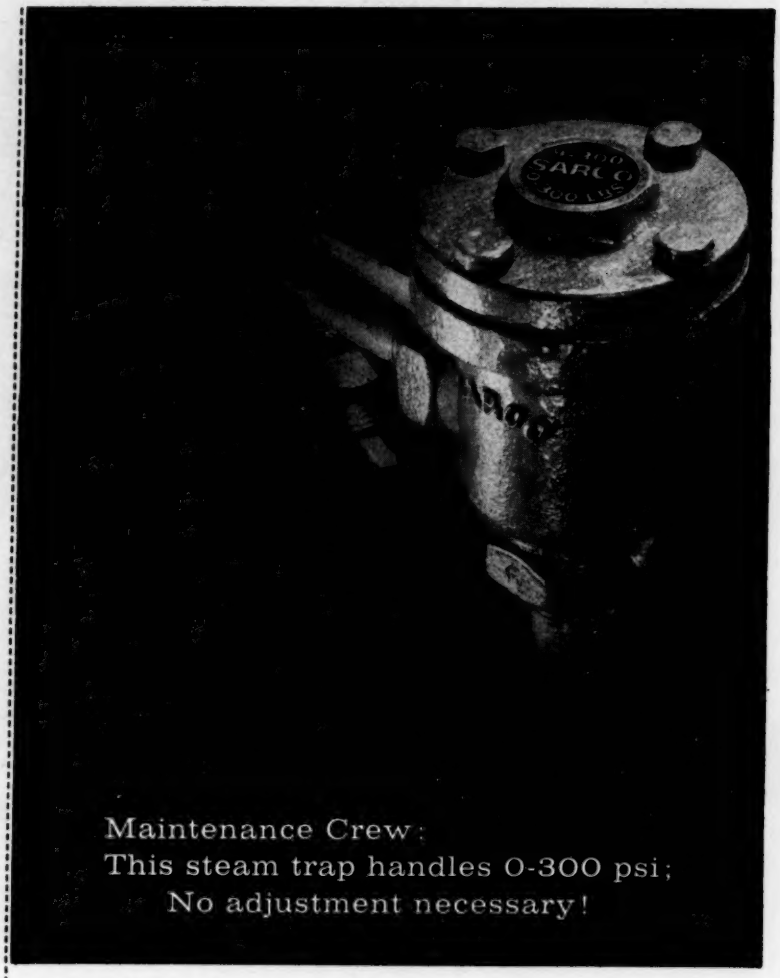



In Sarco Thermostatic Steam Trap, element (A) expands at steam temperature to close valve (B), contracts to permit discharge of condensate.

In the Sarco "Balanced Pressure" Thermostatic Steam Trap a volatile fluid is sealed inside a metal bellows that opens or closes the valve as it contracts or expands with condensate temperature. Near steam temperature, evaporation of the fluid creates an internal pressure greater than steam pressure in the trap body, and the expanding bellows seats the valve. When the condensate cools, the element contracts and opens the valve.

It is evident that at steam temperature pressure inside the element is higher than steam pressure, no matter how the latter may vary. Thus, the trap compensates automatically for variations in pressure.

5810B




Sarco "Balanced Pressure" Thermostatic Steam Traps cut trap maintenance costs and simplify parts inventory. Why? Because the same bellows, head and seat handle steam pressures up to 300 psi – without any need of adjustment for variations in load or pressure.

Other advantages: unmatched capacity/cost ratio (1" size discharges 9,650 lbs/hr. at 10°F below steam temperature, 125 psi). This trap can't air-bind and, when installed with free discharge, can't freeze.

Long life and reliable performance are assured by an exclusive Sarco process for fabricating the one moving part – the thermostat – and by steam-testing of every single trap at maximum rated pressure.

Write for "Literature Kit 1A" today. And remember, Sarco can give you impartial advice on *Production-Planned* steam trapping because . . .

**SARCO**
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

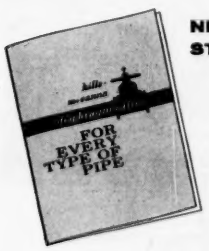
*Only Sarco makes all 5 types:*
*Thermostatic • Liquid Expansion • Float Thermostatic*
*Thermo-Dynamic • Bucket*

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

# How do diaphragm valves in chemical processing affect this young cowpoke?

In chemical processing of all kinds—from "cowpoke vittles" to textile dyes—Hills-McCanna Diaphragm Valves are used because they *cannot* affect chemicals in any way. Hills-McCanna Diaphragm Valves can be made to match the material of any pipe or pipe lining. Moving parts are completely isolated from flow. These valves are not harmed by hard-to-handle liquids or gases and meet the most exacting sanitary requirements.

Maintenance? These are the simplest valves to service. They *never* have to be removed from the line. Whether you handle acetaldehyde or zinc sulfate, Hills-McCanna Diaphragm Valves are worth investigating.

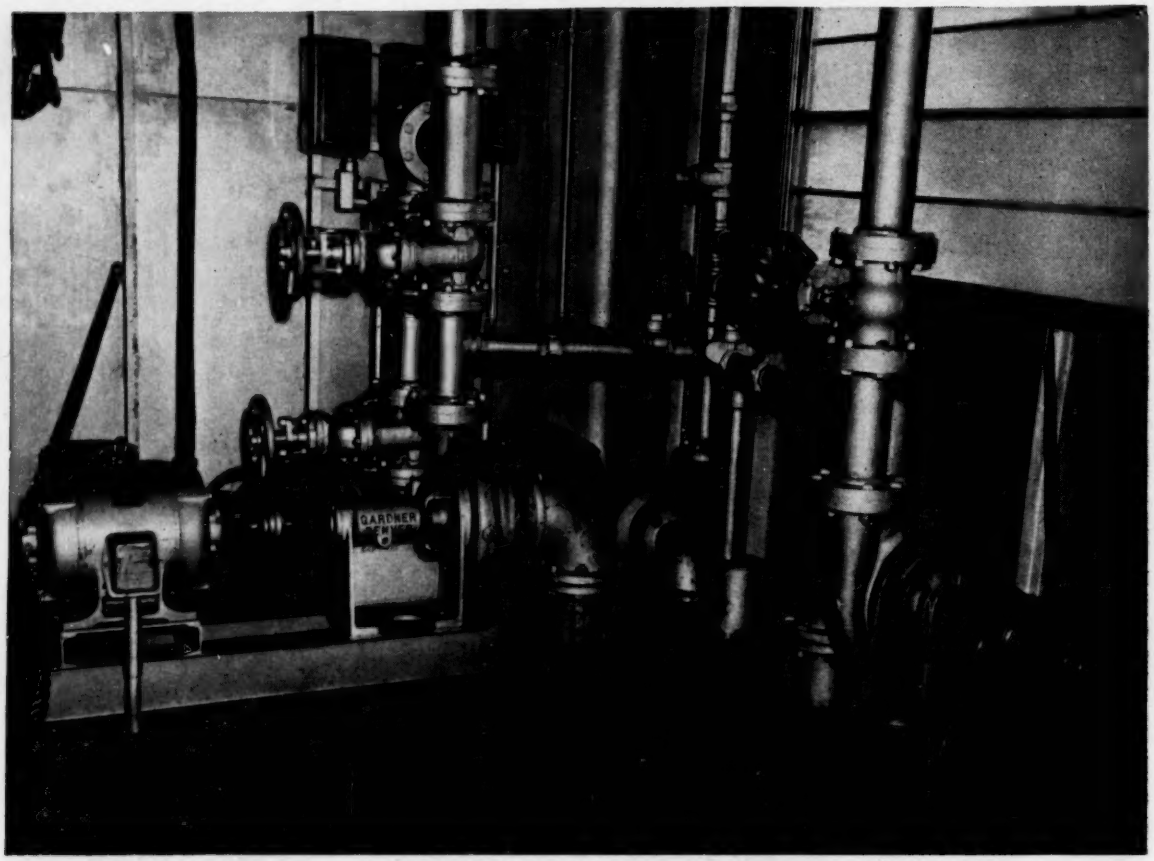



**NEW BOOKLET GIVES INSIDE STORY ON VALVE SELECTION...**

This helpful guide discusses primary considerations in selecting valves, shows engineering principles and benefits of the Hills-McCanna Diaphragm Valve and applications. Write for your free copy today—"Diaphragm Valves for Every Type of Pipe."

**HILLS-McCANNA COMPANY**
4568 Touhy Avenue, Chicago 46, Illinois

*hills-mccanna company*
THE PEOPLE WHO KNOW AND CONTROL FLOW



Your Gardner-Denver pump specialist has a quality pump for heads up to 300 ft.—for capacities up to 2000 g.p.m. See him soon.

# All set for efficient pumping though heads may change...and volume, too

**TESTING NEVER ENDS**

Superior product performance is never an accident. Skilled Gardner-Denver men continually test Gardner-Denver equipment against rigid specifications to insure uniformly high quality in product after product. At Gardner-Denver *there's no substitute for men*—our 100-year philosophy of growth.

Gardner-Denver centrifugals deliver peak performance over a broad range of service conditions . . . take variations in head or volume efficiently. Available in a wide range of sizes—to handle a wider-than-usual range of capacities and pressures. Ask your Gardner-Denver pump specialist to help select the best centrifugal for your application, or write for bulletin.

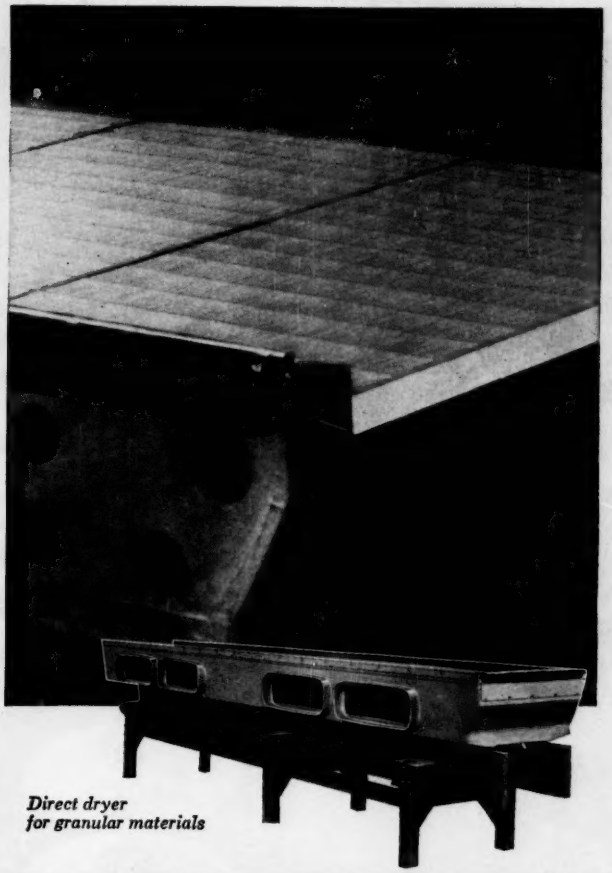
- Extra large shafts to assure continual alignment.
- Heavy-duty ball bearings.
- Casing of high-strength alloy iron produces gradual velocity changes for smooth flow, better efficiency.
- Mechanical seal for long life without attention.
- Hydraulically balanced impellers.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

**GARDNER - DENVER**

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario



*Direct dryer for granular materials*

*Indirect dryer for fine grain materials*

# Continuous drying or cooling at less cost!

## *New Jeffrey units feature variable-amplitude mechanical vibrating drive*

Now proved in service, Jeffrey's new line of mechanical drive dryers is demonstrating lower maintenance and operating costs, in addition to savings in initial investment. Yet these dryers offer the same operating advantages as electric vibrating systems—variable amplitude drive permits adjusting speed of travel and depth of material as desired. Operation is fully automatic; heat transfer is fast and efficient.

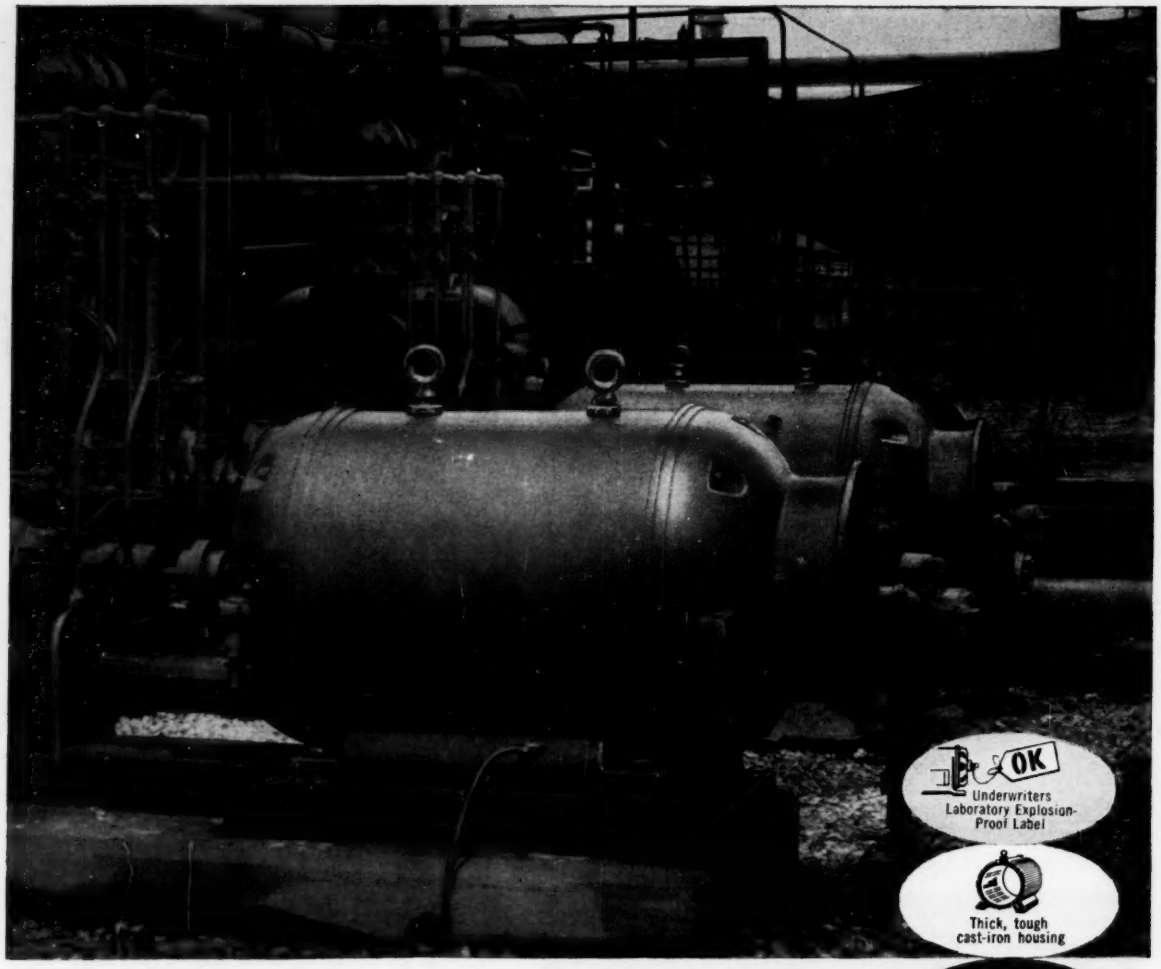
These machines may be used for either drying or cooling and are available in direct or indirect types. They are built in standard lengths of 10 or 20 feet. A tailor-made installation can be assembled from standard components.

The direct dryer is designed to carry granular materials, in the range of ¼" down to about 60 mesh, on a stainless steel conveying surface through which drying air or gas is passed. The indirect type dryer carries very fine grain materials on a solid plate conveying surface, heated from below by low pressure steam or heated air.

Investigate this new cost cutter. For information write, The Jeffrey Manufacturing Company, 909 North Fourth Street, Columbus 16, Ohio.

JEFFREY

**CONVEYING • PROCESSING • MINING EQUIPMENT**
**...TRANSMISSION MACHINERY...**
**CONTRACT MANUFACTURING**




# Tough-shelled, explosion-proof, and corrosion-resistant

## New improvements in Louis Allis explosion-proof motors meet latest demands of abusive chemical service

You need tough-shelled, explosion-proof motors in the corrosive, volatile atmospheres of many of today's modern chemical processing plants.

For this rugged use, Louis Allis, the *originator* of the fan-cooled explosion-proof motor, has continued to develop new designs of direct benefit to the chemical industry: Cast-iron housings with extra-high corrosion-resistance—special varnishes that provide maximum insulation against moisture, acids, and alkali—more effective cooling with aerodynamically designed non-sparking fan.

Now, to match increasing industry demands, Louis Allis offers explosion-proof motors in the *large* sizes — up to 600 horsepower.

What's more, these motors are available in a wide range of mechanical modifications and electrical characteristics to meet many of your requirements.

See the complete story in our Bulletin 800, "Explosion-Proof Motors." Contact your Louis Allis District Office, or write today to the Louis Allis Company, 447 East Stewart Street, Milwaukee 1, Wisconsin.

**LOUIS ALLIS**

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

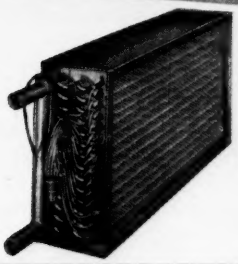
for

- **Heating or Cooling Fluids**
- **Condensing Gases**
- **Evaporating Liquids**
- **Dissipating Waste Heat and other chemical process heat transfer operations**

# Marlo

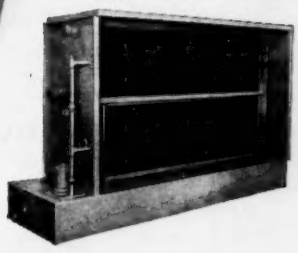
## STAINLESS STEEL EQUIPMENT

*Custom Built to Your Specifications*

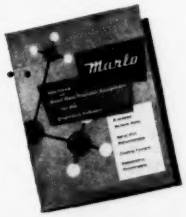


Cooling and Heating Coils

Coil Type Spray Dehumidifiers

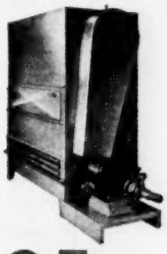


**FREE...**




New brochure on Marlo stainless steel equipment. Write for your copy today.

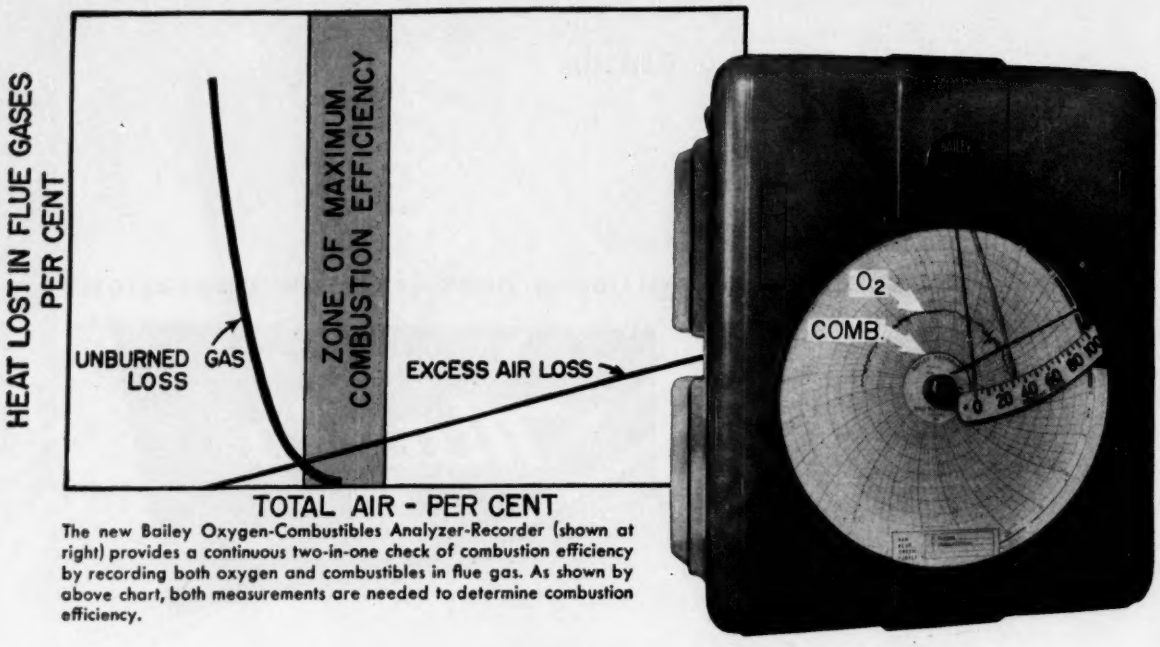
Cooling Towers and Evaporative Condensers



# MARLO coil co.

SAINT LOUIS 11, MISSOURI

**Quality Air Conditioning and Heat Transfer Equipment Since 1925**




The new Bailey Oxygen-Combustibles Analyzer-Recorder (shown at right) provides a continuous two-in-one check of combustion efficiency by recording both oxygen and combustibles in flue gas. As shown by above chart, both measurements are needed to determine combustion efficiency.

# BAILEY announces . . . New 2 in 1 way to measure Heater Combustion Efficiency

The new Bailey Oxygen-Combustibles Analyzer-Recorder gives you a continuing double check on combustion economy. It's fast response measures and records:

**1. Excess air**—regardless of the fuel or combinations of fuels being burned.

**2. The mixing efficiency of your fuel-burning equipment**—by indicating the amount of combustibles in your flue gas, resulting from incomplete mixing of fuel and air.

Combustion efficiency depends upon fuel-air ratio. Too much fuel can be even more costly than too much air. And because of the interdependence of these two factors, no control that measures only one of them can give you complete protection.

Now, for the first time, you can check *both* with a *single* fast acting instrument, using the new Bailey Oxygen-Combustibles Analyzer-Recorder for industrial furnaces, kilns, heaters and boilers.

Fuel economy improves as excess air is reduced —until unburned fuel begins to show up in the flue gas. When this happens, combustion efficiency drops off sharply if there are further decreases in the air-fuel ratio. That's why combustion gases must be analyzed for *both* oxygen and combustibles to get a true indication of efficiency—and that is why Bailey coordinates both measurements on the same chart, to show when excess air may be reduced safely without danger of greater losses from unburned gases.

The Bailey Oxygen-Combustibles Analyzer is an approved combustion safeguard.

Ask your local Bailey engineer for suggestions on application. Equipment details in Product Specifications E65-1 and E12-5. CP107-1

***Chemical and petroleum division***

## BAILEY METER COMPANY

***1054 IVANHOE ROAD • CLEVELAND 10, OHIO***

**In Canada—Bailey Meter Company Limited, Montreal**

# . . . DRY JET FUELS

Jet aircraft now get a new and wider safety margin when their fuels are dried with LINDE Molecular Sieves. Even at high fuel flow rates, water normally absorbed at ground level is reduced to less than 10 ppm—eliminating ice-blocked fuel lines at high altitudes.

Liquids never before dried-successfully by desiccants can now be dried commercially with these new zeolite adsorbents. Examples are acetone and other ketones, ethanol and other alcohols, and most saturated and unsaturated hydrocarbons. Drying to less than 1 ppm is now practical in dynamic systems. Due to their high water adsorbing capacity, LINDE Molecular Sieves bring pronounced savings in investment and operating costs.

No matter what the liquid—whether attempts to dry it have succeeded or failed—we would like to discuss with you what a Molecular Sieve design can do.

Write Linde Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Address Dept. CE-82.

Linde MOLECULAR SIEVES

UNION CARBIDE

"Linde" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

# *It's the Nash!*

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

**No internal wearing parts.**

**No valves, pistons, or vanes.**

**No internal lubrication.**

**Low maintenance cost.**

**Saves floor space.**

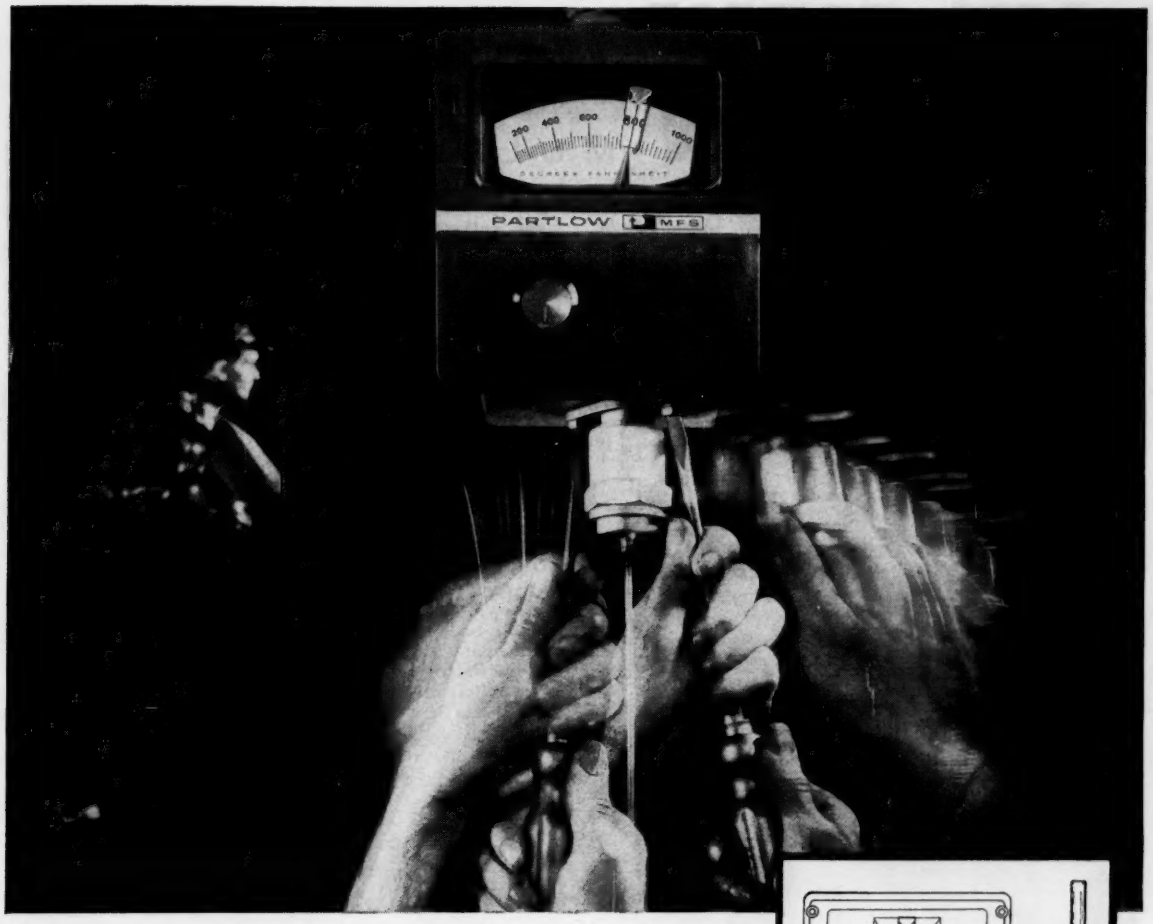
**Desired delivery temperature automatically maintained.**

**Slugs of liquid entering pump will do no harm.**

**75 pounds in a single stage.**

**NASH ENGINEERING COMPANY**

**313 WILSON, SO. NORWALK, CONN.**




## *The Temperature Control Designed for Fast*

# "DO IT YOURSELF" MAINTENANCE

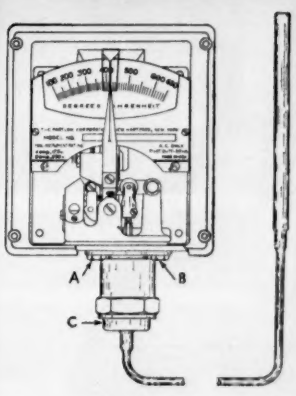
## *Right on the Job!*

Rugged simplicity of design—along with the direct, positive power of mercury-actuation — combine to give Partlow maintenance and performance advantages no other type of temperature control can hope to equal.

Simplicity in the Partlow, for one thing, means that the control element can be changed *at the job site* in a matter of minutes with no other tool than a screwdriver . . . "Down time" is cut to an absolute minimum!

And simplicity in the Partlow also means the complete elimination of fussy electronic gadgets, delicate levers, hairsprings and other accessories that have a tendency to break down at the first trace of jar or jostle. Partlow controls are famous for their unfailingly accurate performance even under the most adverse operating conditions.

If you use or manufacture process equipment within the –30° to 1100° F. range, there's a Partlow pneumatic, electric or self-contained gas control (recording, indicating or non-indicating), to fit your application *precisely*. For details, write The Partlow Corp., New Hartford, New York. Dept. E-859.




*Diagrammatic view of the new MFS reveals "quick-change" feature common to all Partlow controls. In case of damage, merely unscrew at points (A) and (B), and remove element (C) from case. Reverse this process, and your Partlow is ready to resume operation.*

You can pay more but you can't buy better than

**PARTLOW**

**TEMPERATURE CONTROLS**

EXPORT AD. AURIEMA, INC.
85 Broad St., New York 4, N. Y.

# NEW

•An exclusive *TRANTER advancement in heat transfer technology

MULTI-ZONE

# PLATECOIL®

DESIGN

*PATENTS APPLIED FOR

## Years ahead performance plus all of the time-proven PLATECOIL advantages over pipe coils

The new MULTI-ZONE PLATECOIL features a multiple header configuration for improved steam distribution. The resulting increase in effective heat transfer area provides a built-in reserve capacity to deliver more heat during "start-up." It also speeds temporary recovery after introduction of work loads or processing ingredients for closer process control. Decreased condensate "trapping" produces FREE-FLO action.

A.S.M.E. APPROVAL FOR 250 psi. now makes it possible to apply the cost-cutting advantages of PLATECOIL to a new range of heat transfer problems. DURAWELD construction with TRANSTEEL mill-controlled mild steel provides a safety factor of 4 to 1 at 250 pounds steam.

Replace pipe coils with the new MULTI-ZONE PLATECOIL and save on tank space, fabricating, installation and maintenance costs. Factory-fabricated PLATECOIL is available in a wide variety of sizes and styles including single embossed, double-embossed, banked and rolled units in TRANSTEEL, Stainless, Carpenter 20, Monel, Hastelloy C and Nickel.

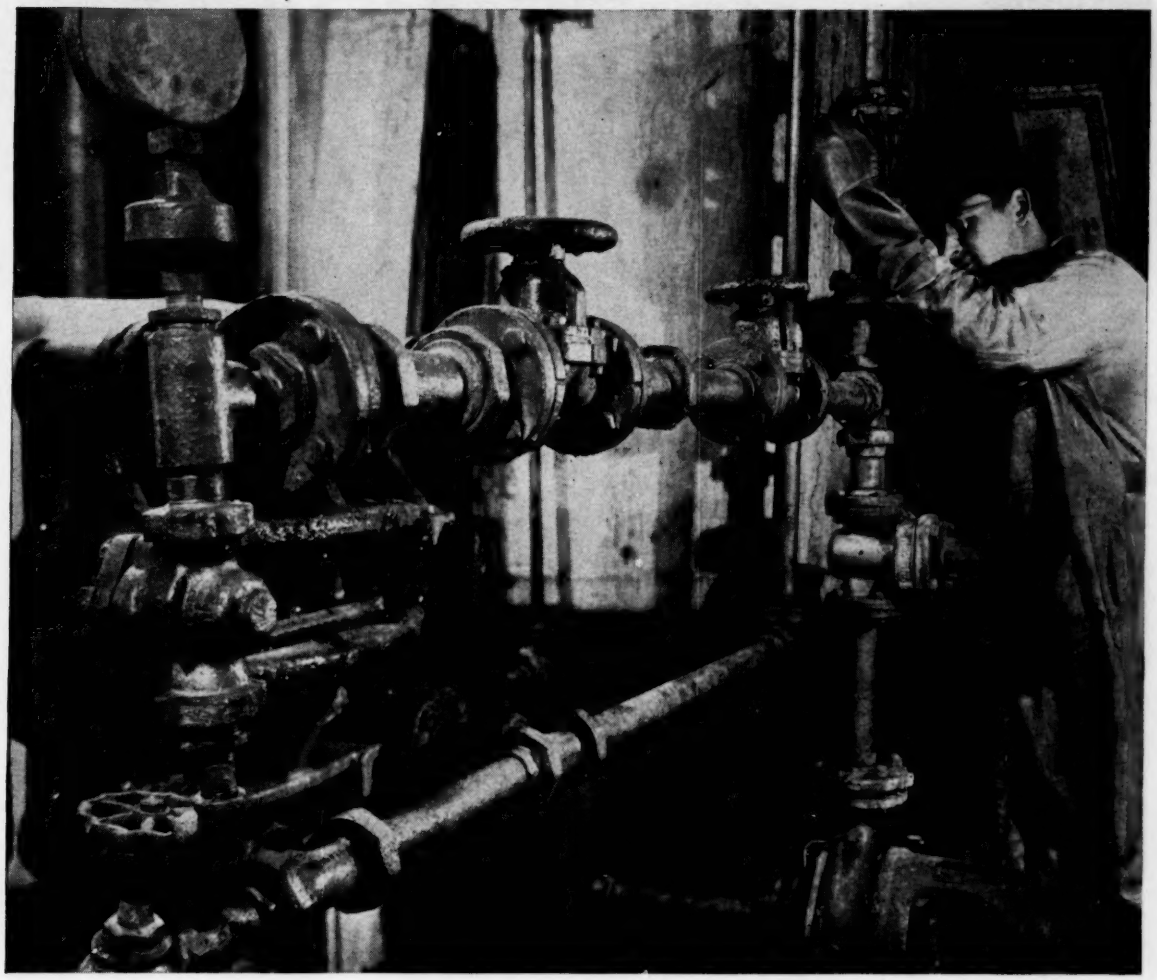
*WRITE FOR NEW BULLETIN P61*
*for complete specifications and data.*

**Tranter Manufacturing Inc.**

**LANSING 9, MICHIGAN**

**PLATECOIL® DIVISION**

DOW | **SARAN LINED PIPE**



# After eight years carrying lithium chloride brine . . .

## no corrosion in SARAN Lined Pipe

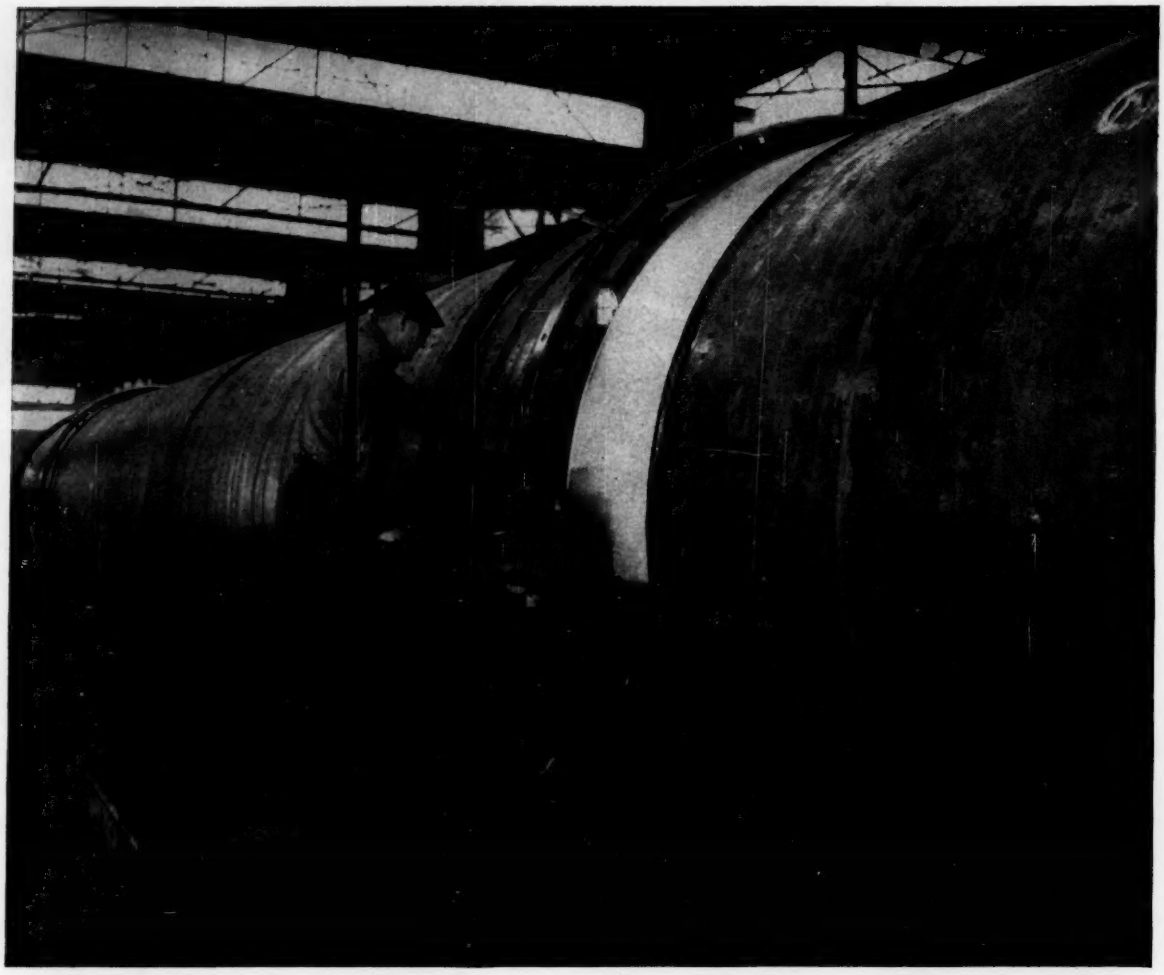
When pipe must carry extremely corrosive lithium chloride brine . . . when floor-level installation freely exposes it to danger of accidental damage from trucks and tools . . . doubly protective SARAN Lined Pipe can mean dependable, low-maintenance operation for many years.

Lithium Corporation of America's Minneapolis, Minnesota, plant produces pure lithium metal as well as various lithium salts. In the production of lithium chloride, SARAN Lined Pipe is used to carry LiCl brine to drying equipment for the removal of water. This brine is extremely corrosive and will quickly eat through steel pipe should a crack develop in the lining. Other SARAN Lined Pipe carries suspensions of lithium fluoride and hydrofluoric acid, a combination which will attack and destroy even glass. Because of its strength and extreme corrosion resistance, there's never been a failure in the SARAN Lined Pipe.

SARAN Lined Pipe at this plant is installed close to floor level in some working areas, constantly exposed to the danger of accidental damage from trucks and tools. Lithium's engineers stated, "SARAN Lined Pipe provides protection from outside damage and from corrosion by the solutions carried. In eight years of pumping LiCl brine through SARAN Lined Pipe at 30 to 50 psi, there's never been a breakdown, and very little maintenance was required."

SARAN Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field, without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2281AK8-24.

**THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN**



# Louisville Dryer—10 feet in diameter, 10 stories long!

Turn a ten story building on its side, and there'd be room to spare on either end of this huge pit lathe at Sharon, Pennsylvania where this 10′ x 110′ Louisville Dryer was fabricated.

This lathe is used for machining the reinforcing bands onto which are mounted the forged steel tires. This careful workmanship assures concentricity of the completed dryer shell—a primary factor in efficient seal operation.

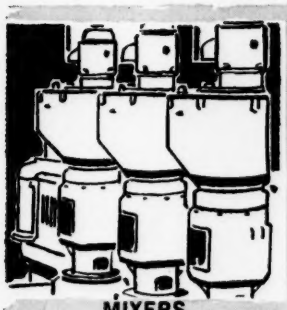
Every Louisville Dryer is especially designed, manufactured, assembled and installed for its specific task.

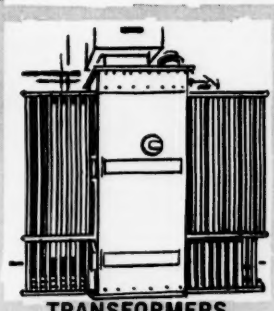
If you have a problem involving process equipment, call or write our equipment specialist in your area. Here, as in so many fields, you'll find IT PAYS TO PLAN WITH GENERAL AMERICAN.

Process Equipment Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
*135 South LaSalle Street, Chicago 3, Illinois*
*Offices in Principal Cities*
*In Canada: Canadian Locomotive Co., Ltd., Kingston, Ontario*

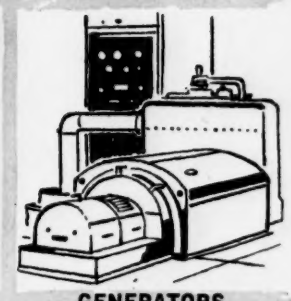
*Louisville Dryers*

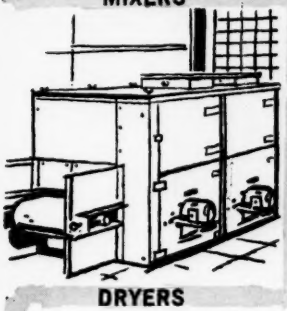
# Which of these common fire hazards threaten you?

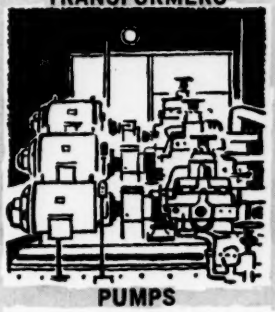

MIXERS

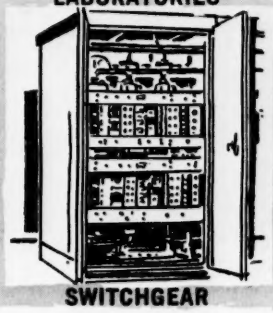

TRANSFORMERS

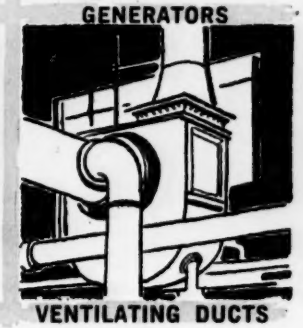
LABORATORIES


GENERATORS


DRYERS


PUMPS


SWITCHGEAR

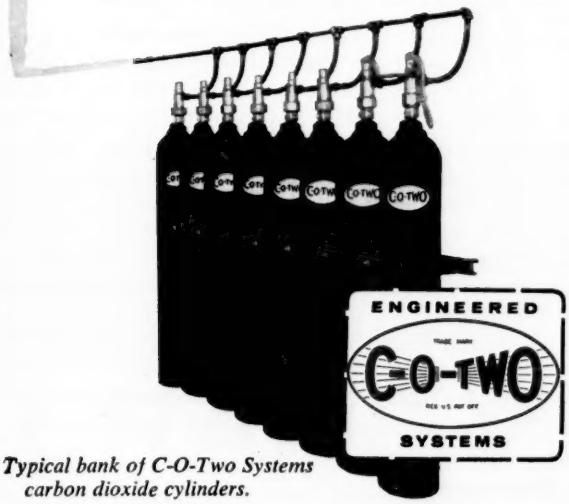

VENTILATING DUCTS

If your plant has one or more of these common fire hazards, ordinary fire protection may not prove adequate! You also need special fixed-type protection that constantly guards specific highly hazardous areas!

C-O-Two Fire Extinguishing Systems are specially designed for closed or partially-closed spaces in which highly flammable liquids or solids are manufactured, handled or stored . . . or where there is fixed or rotating electrical equipment. The C-O-Two line includes dependable, high-quality carbon dioxide, dry chemical or foam systems to extinguish fire, plus detecting systems to detect and locate fire automatically.

Your experienced C-O-Two representative is well qualified to carefully analyze all special hazards. Because he offers the industry's largest line of fire protection products and services, he can make equipment recommendations without prejudice. Each C-O-Two System is carefully engineered and manufactured . . . and C-O-Two will also expertly install the system, if desired.

Why not review your common fire hazards now? If protection is either lacking or inadequate, you can confer at no obligation with your nearby C-O-Two Industrial Fire Protection Engineer! Call him today at these offices:




*Typical bank of C-O-Two Systems carbon dioxide cylinders.*

products of
**THE FYR-FYTER COMPANY**

ATLANTIC COAST REGIONAL OFFICE
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CENTRAL STATES REGIONAL OFFICE
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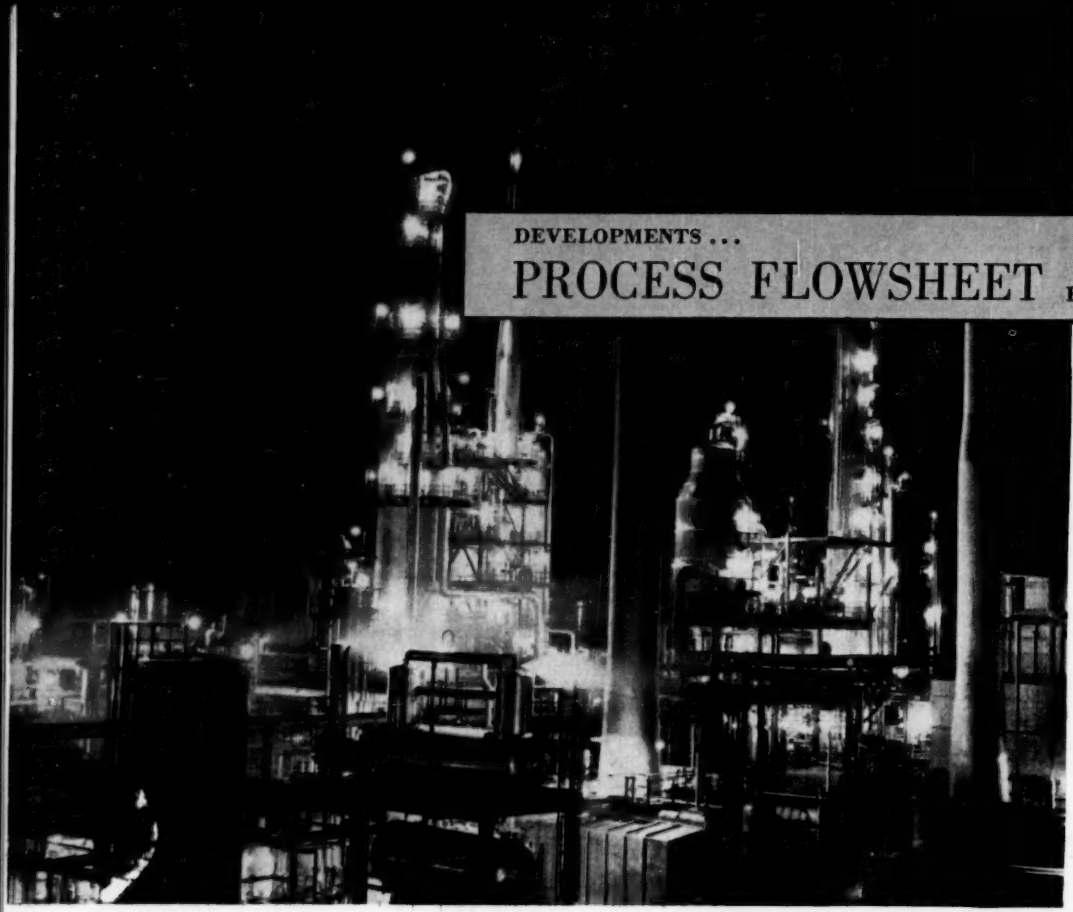


DEVELOPMENTS . . .

PROCESS FLOWSHEET

R. A. LABINE

## Unusual refinery unit produces . . .

# Phenol-Free Waste Water

## . . . Using ozone, other innovations.

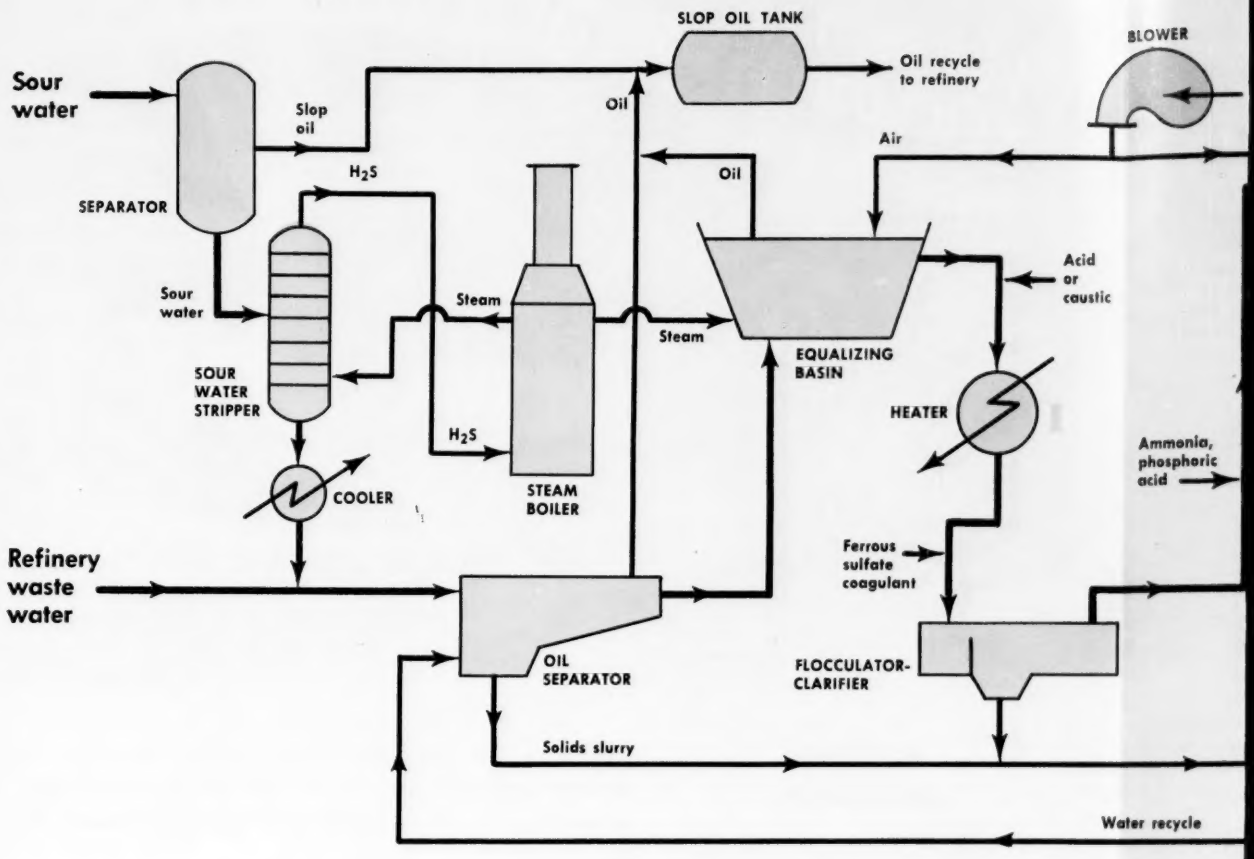
To realize the important role that pollution control plays in today's industry, you just have to take one look at Cities Service's new 20,000-bbl./day Trafalgar refinery in Bronte, Ont. At that $24-million installation, close to $3 million has been spent on facilities to prevent atmospheric and water pollution. And the waste water treating plant, which has to meet stringent "suggested" local regulations (example: no more than 0.015 ppm. phenols in effluent), gets feature billing at the refinery—complete with aquariums and fountains utilizing the purified waste water.

Although the heart of the waste treating plant is a relatively standard biological oxidation process, plant is unique in its combination of units to give what is probably the purest waste water in the petroleum or chemical industries (see table). From an engineering standpoint, the waste plant has three interesting features: (1) Ozone for final phenol removal; (2) Improved aeration tank design to give high biological oxidation efficiencies; (3) Housing of all units to maintain optimum 95 F. temperature for biological phenol removal.

▶ **Ozone Cleanup**—Use of ozone for oxidation of phenols is believed to be unique in the petroleum industry.

Water from the holding basin (see flowsheet) contains about 0.38 ppm. phenol after biological treating. Passing through the ozone contactor—a stainless steel vessel 20 ft. high and 15 ft. dia.—

Unfold Flowsheet




drops phenol level to around 0.012 ppm. Ozone also disinfects the water and improves appearance and taste. Addition of 2 ppm. activated carbon removes last traces of chemical impurities and brightens the color. Sand filters remove the carbon before discharge to Lake Ontario.

Cities Service picked ozone treating rather than chlorine or chlorine dioxide because chlorination produces chlorophenols with more objectionable odor and taste than phenol itself while operating costs for a $ClO_2$ unit are higher than the ozone unit. The 15,000-v. ozone generator produces ozone from atmospheric oxygen for about 8-9 kwh./lb. ozone; total generating capacity is around 190 lb./day. Ozone is diffused into the water in the ozone contactor through perforated carborundum pipes at the base of the vessel.

▶**Process Flow**—Design capacity of the Trafalgar waste plant is 300 gpm., but it has handled up to 600 gpm. satisfactorily.

Most of the refinery waste water collects in a main sewer and runs to the oil separators. Sour water containing $H_2S$ collects separately and feeds to a tray tower for stripping. From stripper, water flows to the oil separator and combined streams are pumped to the equalizing basin—large enough to hold one day's flow. Air bubbles into this basin to promote oxidation and to insure thorough mixing; steam pipes provide against freezing in the winter.

Water from equalizing basin is adjusted to a pH of 8.5 and heated to 95 F. for optimum biological oxidation. Flocculating with ferrous sulfate collects most of the suspended solids. As water flows from the flocculator-clarifier to biological treating, ammonia and phosphoric acid nutrients for the bacteria are added.

▶**Biological Banquet**—Activated bacterial sludge used in the Cities Service plant is same as used in any municipal sewage plant—after allowing bac-

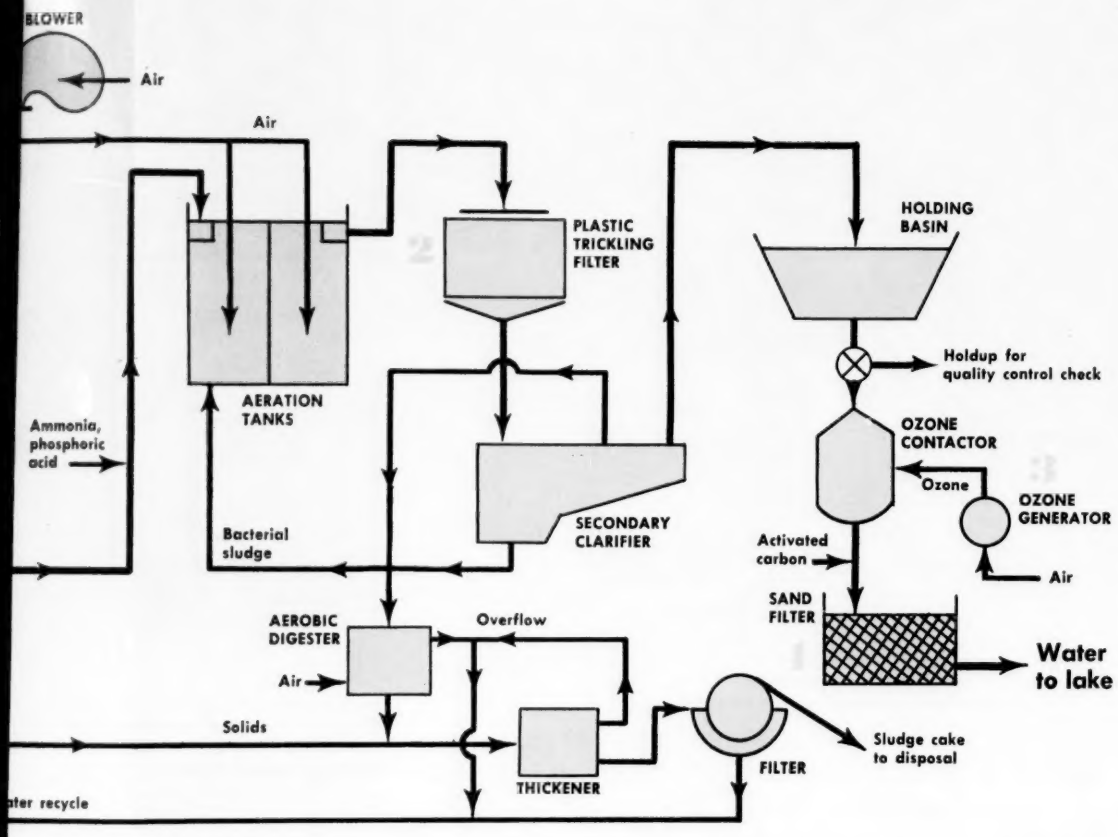
teria to be
diet.

Initial c
organics
with 9-hr.
in the se
water to
tank thro
whole leng

**Process P**

| | |
|---|---|
| Phenol | |
| Oil | |
| Suspended so | |
| Sulfides | |
| Ammonia | |
| BOD | |
| pH | |

1. Effluent from




teria to become accustomed to the special refinery diet.

Initial oxidation to consume phenols and other organics carries on in two-stage aeration tanks, with 9-hr. holdup in first tank and 3-hr. holdup in the second stage. Method of feeding waste water to these tanks is novel: Water flows into tank through an overflow launder running the whole length of one side. Air blown into the tanks provides an over-under rolling motion for complete mixing. Feeding along the entire length—rather than at one point or several points—gives a uniform concentration profile across the tank and gives higher oxidation efficiencies.

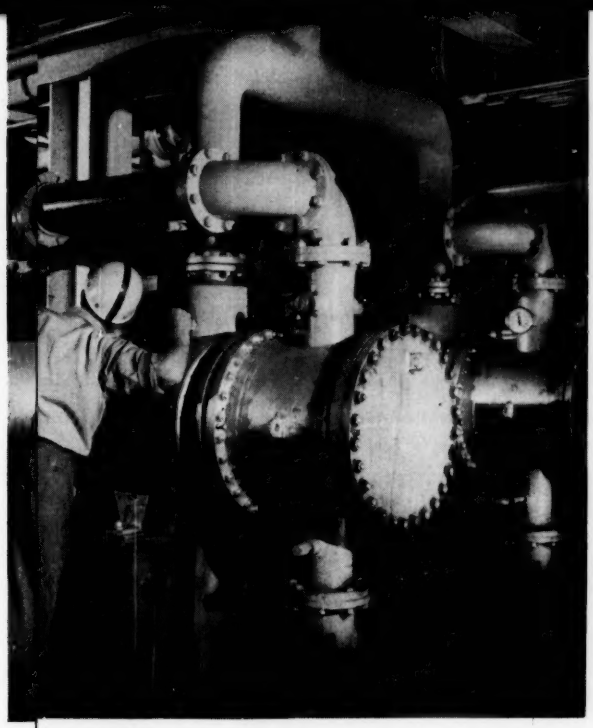
**Process Produces Practically Pure Water**

| | Incoming Water[1] | Effluent |
|---|---|---|
| Phenol | 55 ppm. | 0.012 ppm.[2] |
| Oil | 89 ppm. | nil[2] |
| Suspended solids | 128 ppm. | 2 ppm. |
| Sulfides | 13.5 ppm. | nil |
| Ammonia | 110 ppm. | 16 ppm. |
| BOD | 378 | 5 |
| pH | 8.3 | 7.3 |

1. Effluent from the oil-water separator. 2. Determined by infrared absorption.

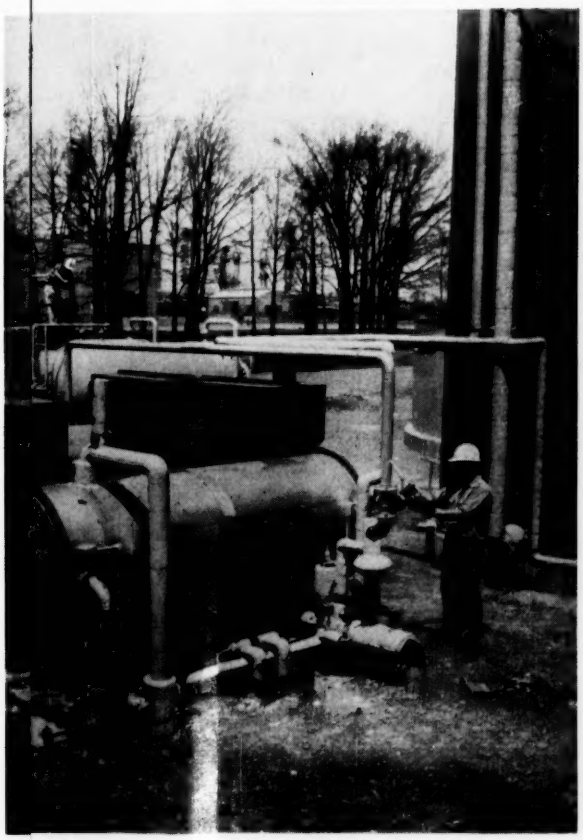
► **Plastic Bug House**—From aeration tanks, water flows to plastic "Dow-Pac" trickling filters. In the honeycomb plastic packing (17 ft. dia., 20 ft. thick) live the same type of bacteria as in the aeration tanks. These bacteria consume most of the remaining chemicals—particularly phenols. Plastic filters perform the same function as trap-rock trickling filters used in the petroleum industry (*Chem. Eng.*, Mar. 23, 1959, p. 94) but are more efficient because the plastic has greater surface area per unit volume.

From the trickling filters, water flows through a clarifier to the holding basin where it undergoes quality control checks before flowing through final polishing steps and then to Lake Ontario.



T EXCHANGERS raise water temperature to
. prior to biological removal of oil and phenols.

TRICKLING FILTERS (right) contact waste water with bacteria residing in the plastic packing.



NE GENERATOR operates on atmospheric oxy-
ozone contacts water in vessel on the right.

SAND FILTER removes activated carbon and any turbidity, giving a crystal clear, potable product

# BARNSTEAD BANTAM DEMINERALIZER

## DOES 5 WATER PURIFICATION JOBS
## EMPLOYS 5 INTERCHANGEABLE CARTRIDGES

**STANDARD CARTRIDGE**
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For operations demanding better than 1,000,000 ohms resistance and neutral pH. Cartridge capacity is 1230 grains as NaCL (1050 as $CaCO_3$). Approximately ⅔ of cartridge capacity is million ohm water or better. The pH is usually between 6.8 and 7.2 with water being largely free of silica and $CO_2$.

**ORGANIC REMOVAL CARTRIDGE**
Removes organics, organic liquids and gases that would pass through a demineralizer. Effective in removing chlorine. Ideal for pre-treating demineralizer feedwater, for self-purifying high purity rinse systems and other processes where organics or odors in the water are objectionable. One cartridge removes organic matter from about 1500 gallons of average water.

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Developed for cooling water loops where it is important to maintain low oxygen content to prevent corrosion. Cartridge removes one part per million of dissolved oxygen from 2500 gallons of water, or 6.8 liters (9.7 grains) of oxygen at standard temperature and pressure. For use with water having less than 10 ppm total ionizable solids.

**CATION CARTRIDGE**
Provides (1) precious metals recovery, (2) radio-active isotope recovery, at low cost, (3) also useful for removing volatile amines where heating plant steam condensate is being used as the feedwater for a Still, and (4) where close control over the pH of water is necessary, the cation cartridge in its ammonia or lithium form is effective.

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**STILL AND STERILIZER CO.**
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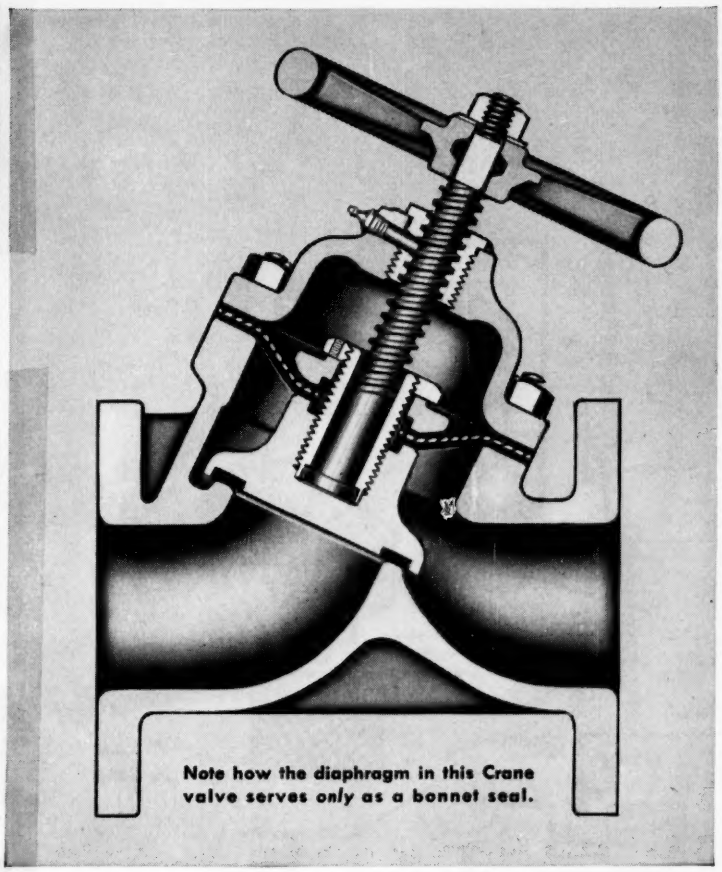
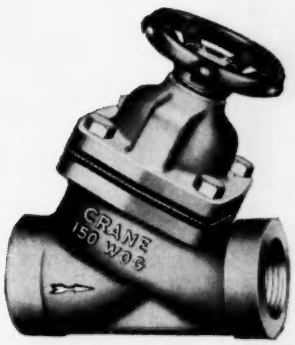
Shown at right: Barnstead Pressure Bantam Demineralizer. Delivers demineralized water under pressure. Flow rate 8 to 25 gallons per hour. Indicating light shows when cartridge needs replacement. Takes same cartridge, does same jobs as regular Bantam Demineralizer.

***PURE WATER SPECIALISTS SINCE 1878***



Note how the diaphragm in this Crane valve serves *only* as a bonnet seal.




Crane screwed-end diaphragm valve: ½" to 2". Flanged ends: ½" to 14". Four body materials; five trims. Special body and trim materials available on order.

Lined valves—flanged ends only. Neoprene and hard, natural rubber linings regularly available. Other linings on special order.

# Crane separates disc and diaphragm to make diaphragm valves last longer

**NOW IN SIZES UP TO 14 IN.**

The diaphragm in ordinary valves is stretched to serve as a disc as well as a bonnet seal. This makes it vulnerable to crushing, cutting and abrasion. Result: accelerated wear . . . threat of rupture . . . frequent diaphragm replacement.

*Not so with Crane diaphragm valves.* The diaphragm has only *one* function: sealing the bonnet against line fluids. Result: diaphragm lasts longer—there's less valve maintenance cost. The disc is a *separate unit* and shuts off flow even if the diaphragm should fail.

### Typical added Crane features

*Y-pattern body* offers least resistance to flow, minimizes pressure drop . . . *flat-faced disc* with durable, resilient insert ring resists erosion; seats tightly . . . valve operation requires lower torque; fewer turns.

### Handle all types of fluids

Crane diaphragm valves are available for a wide variety of services—from water, air and gas to corrosive, volatile and hard-to-hold liquids. They are supplied regularly with bronze, cast iron, aluminum or stainless steel body—with neoprene, buna N, natural rubber, Kel-F or Teflon trim. Neoprene or hard, natural rubber lined valves also supplied. Other body materials, trims and linings on special order.

For complete details, consult your Crane Representative or write to address below for bulletin.

Ask for *new* Bulletin AD-1942

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1. Rugged construction and slow speed insure utmost dependability and minimum maintenance.
2. Whizzer separator gives a wide range of fineness with finger-tip control.
3. Automatic feed control assures maximum capacity — with only part of one man's time required for the mill operation.
4. Combined operations of pulverizing, classifying and conveying offer economies and simplification in plant design.
5. Flexibility of layout.
6. Dust-free operation.

*For further details, write for the Raymond Roller Mill Catalog #79.*

THIS huge 66″ Raymond Roller Mill is the *heart* of the modern equipped plant of the Federal Foundry Supply Division of Archer-Daniels-Midland Company at Colony, Wyoming.

The raw bentonite is first reduced in a slicer ahead of an 8′ diameter by 60′ long rotary dryer where the moisture is reduced from 30% down to 8%-10%.

The Raymond Roller Mill then pulverizes, classifies and conveys the finished material to storage silos, where the product can go to bag packers or bulk loaders.

This Super Roller Mill has a rated capacity of 500 tons per day at a fineness of 90% minus 200 mesh. It can produce various grades, with classification easily controlled over a wide range.

Archer-Daniels-Midland Company has incorporated automatic control features in the system to permit operation of the entire plant by two men on a shift.

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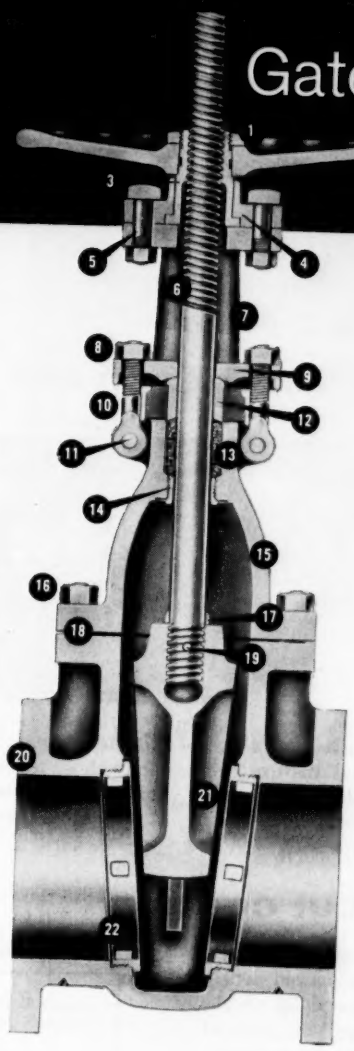


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5 Steel yoke cap bolts and nuts
6 TYPE 316 STAINLESS STEEL spindle
7 NI-RESIST CAST IRON, TYPE 2, yoke
8 Bronze eye bolt nuts
9 Malleable iron gland flange
10 Steel gland eye bolts
11 Steel gland lug bolts and nuts
12 TYPE 316 STAINLESS STEEL gland
13 Teflon impregnated asbestos packing
14 TYPE 316 STAINLESS STEEL bonnet bushing
15 NI-RESIST CAST IRON, TYPE 2, bonnet
16 Steel bonnet bolts and nuts
17 TYPE 316 STAINLESS STEEL spindle ring
18 Asbestos gasket
19 TYPE 316 STAINLESS STEEL wedge pin
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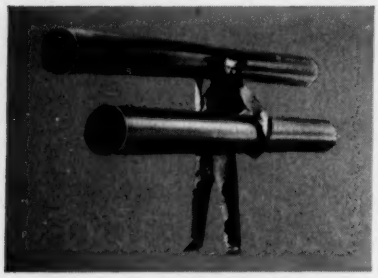

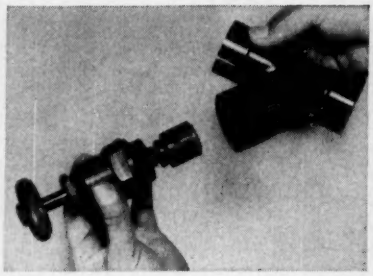

Ryertex-Omicron PVC is an exceptionally versatile industrial plastic with outstanding resistance to 281 corrosive solutions and gases. Its light weight (only 1/6 that of steel) and its great strength are but two of its money-saving advantages. It is nontoxic, noncombustible, nonmagnetic and nonsparking. It is immune to weather, rotting and aging.

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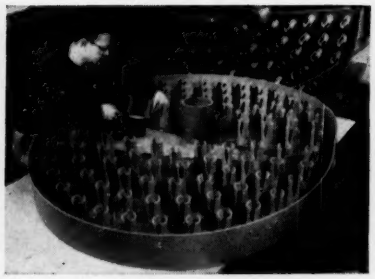

You can choose PVC pipe in sizes from ½" through 14". Valves, flanges and fittings are precision-made by injection molding. Bars and sheets are fully extruded, not laminated.

The techniques of fabricating PVC are similar to those for metal. PVC can be cut, drilled, formed, bent, welded, threaded and machined ... is easy to assemble and install.

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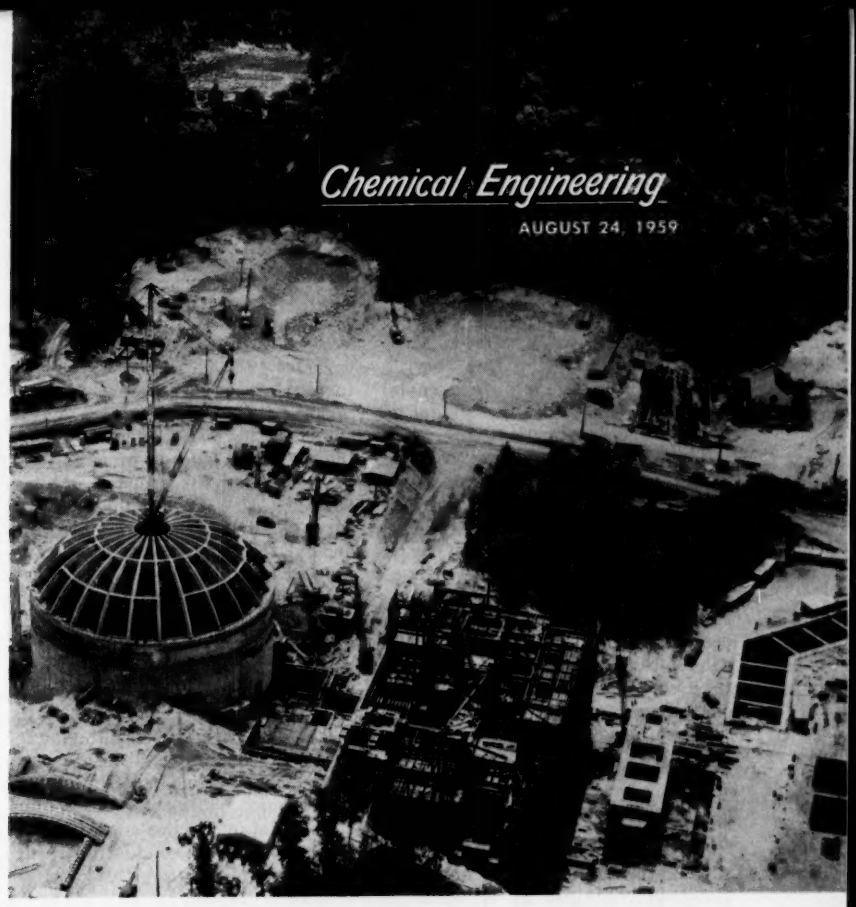



## Chemical Engineering Unit Operations Help . . .

# Solve Atomic Power Plant Problems

**Chemical engineering plays vital role in design of N. Y.'s abuilding Indian Point nuclear power plant.**

**C. F. STOLZENBACH, Consolidated Edison Co. of N. Y.**

IT IS not commonly recognized that chemical engineering enters into almost every phase of design and operation of a nuclear power plant. Many unit operations are used in nuclear power: heat transfer, fluid flow, evaporation, distillation, gas stripping, gas absorption, ion exchange.

Of specific concern to chemical engineers are such diverse problems as:

- Choice of materials of construction to resist corrosion and radioactivity.
- Handling and disposing of hydrogen and oxygen — cooling-water-decomposition products due to radioactivity.
- Preparation of ultra-pure feed water for the reactor coolant cycle.
- Handling of solid, liquid and gaseous radioactive wastes.

This article will not attempt to evaluate the merits of various re-

actor types but will deal specifically with the role of the chemical engineer in design of a thermal-neutron, pressurized-water nuclear power plant. Reference will be made to the nuclear power plant being built for the Consolidated Edison Co. at Indian Point, N. Y. (consultants and architects: Vitro Engineering Co.). It is scheduled for completion in April 1961 (see photo, p. 123).

This reactor uses highly enriched uranium oxide, homogeneously mixed with thorium oxide to breed fissionable U-233 in addition to power. The core is cooled by a stream of water at a pressure of 1,500 psia. and an average temperature of about 500 F. This primary coolant water will generate 405 psig. saturated steam in a shell-and-tube heat exchanger from a stream of secondary water.

### Severe Metal Problems

It is desirable to put the fuel in a container to prevent solution of the fission products in the primary water stream. Choice of materials for this container or cladding is quite limited, and complicated when an oxide fuel* is used. With metallic uranium, a metal container or cladding can be bonded directly to the fuel or an alloy of uranium can be bonded to a metallic cladding. This is not possible with the nuclear-oxide fuels.

Use of oxide fuels causes considerable difficulties with heat transfer. Fission heat is transferred by conduction through the ceramic-type oxide (which has a very low thermal conductivity) and the metallic cladding or container; by convection through the gas gap between the fuel and cladding, through the stagnant gas film around the fuel and the inner surface of the cladding, and through the stagnant water film around the outside of the cladding. In some designs the $\Delta T$ between the fuel cylinder center and the water coolant is as high as 30,000 F./in. of heat travel.

Choice of a suitable material for the fuel element cladding narrows down to materials which: contain the fission fragments; are corrosion resistant to the coolant; have a high thermal conductivity; are stable in radiation fields; do not become highly radioactive in the reactor core radiation field; have adequate strength at operating temperatures; are ductile; and have a very low neutron absorption probability. There is no perfect metal meeting all these requirements, but stainless steel, zirconium and its alloys and aluminum are used.

At Indian Point, cylindrical pellets of sintered uranium-thorium oxide are loaded into 0.3125-in.-O.D. × 0.020-in.-wall Type 304 stainless-steel tubes. The gas gap between ceramic pellets and tube is filled with helium. A subassembly of 196 tubes, arranged in a square lattice with an 0.3805-in. pitch is enclosed in a 6-in. × 6-in. Zircalloy can. Cooling water flows upward inside of these cans and around the outside of the stainless-steel tubes. The 500 F. primary water is pumped through four parallel heat exchangers to generate steam. Primary water flows through Type 304 stainless-steel heat-exchanger tubes. Secondary water will be in contact with these tubes and the shell.

### Ultra-Pure Water

Maintenance of primary water purity is another vital chemical engineering operation. The high neutron flux in the core decomposes water to produce oxygen and hydrogen. Since this is undesirable, means must be provided to collect these gases and safely dispose of them. Dissolved oxygen in the hot primary water accelerates the corrosion rate of fuel cladding. This

* Oxide fuels are popular because they are more resistant to corrosion, radiation damage and thermal cycling than metal fuels.

**Consolidated Edison's Nuclear Power Scheme for Indian Point**

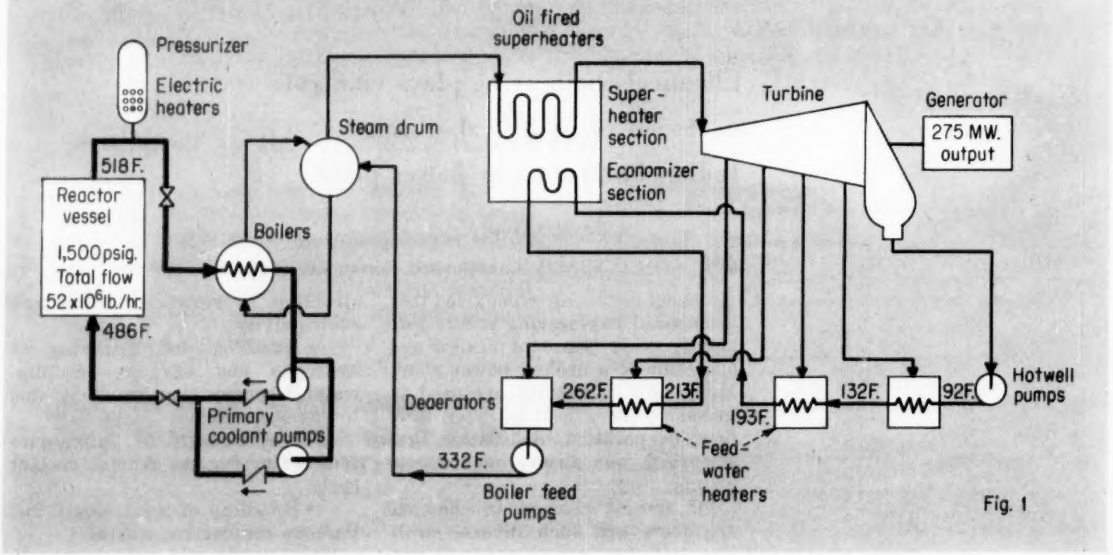



Fig. 1

decomposition is avoided by maintaining an excess of dissolved hydrogen gas in the primary water. At Indian Point, the primary water contains about 40 cc. (STP) of dissolved hydrogen gas per kilogram of water. The equilibrium dissolved oxygen in this water will be approximately zero.

However, stainless steel will corrode even in this water at the rate of about 10 mg./dm.²/mo. and "crud" or corrosion products will be formed both in place on the metal surfaces as an oxide scale and in solution or suspension in the primary water. Passage of metallic oxides through the reactor core will cause transmutation into radioisotopes. Some of these are quite long lived: Co-60 with a 5.2 yr. half life can be produced from Ni-60 or from Co-59. It has been reported at APPR (the Army Portable Package Reactor at Fort Belvoir, Va.) that Co-60 activity in the primary loop has continuously increased since start-up and is now the major activity component in the water and on the metal surfaces.

### When Fuel Element Fails

If there is a defect in the fuel-element cladding or a break in the fuel elements, primary water will contain dissolved and suspended fission fragments and possibly uranium and thorium. It has been found that suspended material will not only settle out in areas of low-liquid velocity but also on surfaces with a high heat or radiation flux such as fuel elements. Therefore, the heat transfer surfaces in the reactor core and heat exchangers become contaminated with a deposit. This not only reduces heat transfer but presents difficulties in repair and maintenance of equipment. The radiation level due to the deposit can be very high—enough to require extremely short working periods to avoid excessive radiation exposure.

At Indian Point, and most pressurized-water reactors, a continuous blowdown stream is withdrawn from the primary loop for purification. This amounts at Indian Point to about 36,000 lb./hr. normally, which may be doubled if necessary. Such a stream preheats an equivalent amount of makeup water sent into the primary loop. Blowdown is reduced in pressure to about 30 psig., sufficient to keep in solution all dissolved hydrogen added to the system.

### Removing Gases

In the event of failure of the fuel-element cladding, some of the radioactive gaseous fission products—bromine, iodine, xenon and krypton—will be released into the primary loop water. These will be steam stripped from the primary loop blowdown.

However, removal of rare gases from solution is not a simple job. Calculations indicate that the concentration of krypton and xenon in the feed to the gas stripper will be of the order of 20 cc. (STP)/million liters of water, or about $2.0 \times 10^{-3}$ ppm. And this is considerably less than the concentration produced in most commercial types of degasifiers. It was desired to reduce the rare gas concentration in our product to $2.0 \times 10^{-8}$ ppm. Design of such a degasifier is not exact. Data for gas solubilities and distribution coefficients for these gases and concentrations are not available.

A degasifier has been purchased which converts a considerable fraction of the liquid into steam by means of a closed tubular steam heater. This steam scrubs incoming feed liquid countercurrently in a packed tower. Vapors from the tower top are partially condensed to furnish reflux, and gases with carrier steam withdrawn. These gases go to the waste gas handling system for processing, hold-up for decay and ultimate disposal.

Since the primary loop water contains 30-40 cc. (STP) of hydrogen gas/kg. of water, the gaseous waste is practically entirely hydrogen gas with only traces of these radioisotopes. To reduce volume of gases, the waste gases mix with oxygen and the hydrogen burned by passage through a platinum catalyst. The oxygen-hydrogen mixture is close to stoichiometric with only a very slight excess of oxygen, and will therefore be in the middle of the explosive range. To prevent possibility of explosion in the catalytic combustion, sufficient nitrogen has to be recirculated and mixed with the oxygen-hydrogen mixture to bring it below the explosive range. Oxygen addition is controlled by an oxygen analyzer in the catalyst outlet gas to maintain less than 0.5% by volume oxygen in this outlet.

The waste gases, after removal of hydrogen, are stored for about 150 days in holdup tanks to permit all of the expected gaseous radioisotopes to decay with the exception of the krypton-85. This residual gas discharges up the superheater stack, 400 ft. above grade, and dilutes with the superheater combustion gases.

### Removing Solids

Suspended solids in the primary water will be oxides and hydroxides from corrosion of stainless steel and Zircalloy plus fission fragments and fuel in the event of fuel element failures. They are removed at Indian Point by filtration.

An entirely satisfactory filter design is not available for handling these highly radioactive solids. If a cellulosic or ceramic filter element is used, backwashing to remove slimy solids is not practical and it is therefore necessary to remove and discard the filter elements. This is easier said than done. Filters will be in a shielded chamber or pit and the filter container must be opened, the filter elements removed and placed in shipping containers—all remotely.

Final disposal of the fouled filters is also a difficult operation. If an edge or wire-screen filter is used, a precoat of filter aid will be necessary to achieve good separation of the fine solids. It is necessary to develop a method of precoating the filter elements while they are in place in the shielded compartment. Backwashing the cake off the filter at the end of the cycle should permit transfer of a slurry of filter aid and corrosion products to some waste disposal unit.

Soluble materials in the primary loop water are removed at Indian Point by passing the water through a cation-resin ion-exchanger followed by a mixed bed of cation and strong-base anion resins.

This purification system is designed for high efficiency of removal. Specifications for the primary water at Indian Point call for a maximum of 1.0 ppm. of total dissolved solids and a maximum of 1.0 ppm. of total suspended solids.

There is some uncertainty regarding the life of these ion-exchange resins since the inlet concentrations will be close to the outlet concentrations of many present ion exchanger installations. In gen-

eral, capacity of resins decrease with inlet ionic concentrations. The capacity of resins for some of the more unusual chemical elements which may be expected in the event of a fuel element failure is not too well established. For example, zirconium is a major component of the fission products and can appear in the corrosion products from the Zircalloy cans in the reactor core. Zirconium does not produce any ions per se and would be present in solution only as part of complex ions, both cationic or anionic, and would probably be present in large part as a colloidal dispersion. Removal of zirconium by ion-exchange resins in these concentrations and forms will probably not be too complete or efficient.

### Control Rods and Boric Acid

The Indian Point reactor has been designed to produce 600 full power days with the core. This is a relatively long life and involves a high burnup of fissionable nuclei. Therefore, the new clean core has a considerable amount of excess enrichment. Rather than provide sufficient control rods to keep the core subcritical in the initial start-up, control is made by the 21 control rods plus boric acid added to the primary loop water.

Calculations indicate that an initial boric acid concentration of about 12,000 ppm. will be satisfactory. This boric acid can be removed, in part, by diluting the primary loop system with makeup water and blowing down the borated water to the liquid waste system. Dilution with three loop volumes should bring the boric acid concentration to about 250 ppm. This is removed by passing the primary loop blowdown through the filters, cation-ion exchanger, and a strongly basic-anion-resin exchanger. The mixed-bed exchanger has to be bypassed during this period to conserve resin and will be put into operation only after the anion exchanger has removed practically all the boric acid.

Fig. 2 shows flow of this blowdown purification loop.

### Chemical Monitoring

It is apparent that a considerable amount of chemical monitoring is necessary to determine and control dissolved hydrogen concentration in the primary loop, suspended solids after the filters, dissolved fission gases before and after the degasifier, total dissolved solids and activities before and after the cation and mixed-bed ion exchangers, etc. In addition, samples must be taken to determine quantity of suspended crud and composition of corrosion products. Presence of fission products in the primary water must be determined periodically.

Analytical methods are a combination of chemical and radiochemical methods. Gamma ray spectrometers determine presence and concentration of specific radioisotopes. However, due to interferences between radioisotopes, it is usually necessary to make a chemical separation of groups before the gamma spectrum step. Since concentrations of most elements are extremely small, separations are pos-

**How to Purify Primary-Loop Water**

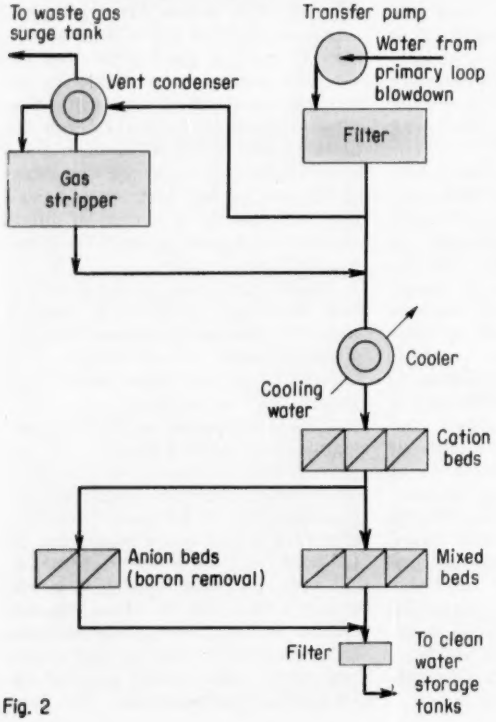



Fig. 2

**Handling Liquid Wastes at Indian Point**

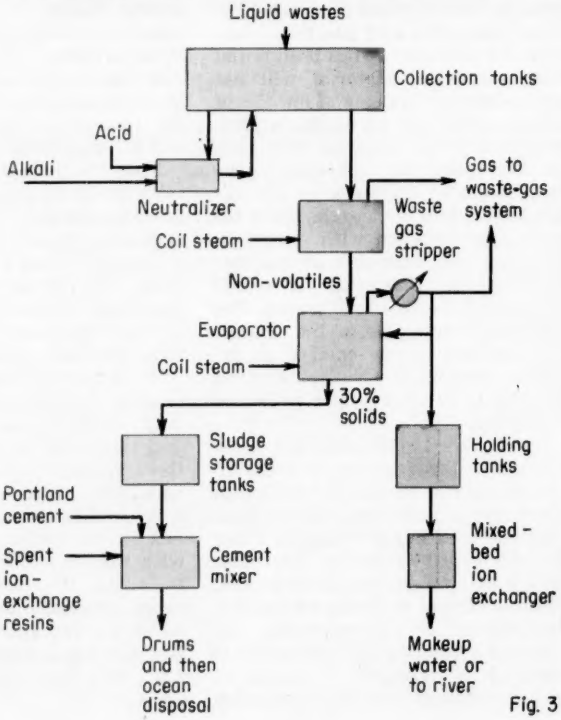



Fig. 3

sible only if carrier materials are added to the original solutions. Since yields of these separations are usually low, as is also the efficiency of the gamma counters, there are a considerable number of instrument calibrations in which known quantities of standard radioisotopes are put through the procedure.

### Feedwater Must Be Pure

Feedwater to the primary loop must, of course, be as pure if not purer than the specifications for the loop water: less than 1 ppm. total dissolved solids and no dissolved oxygen. This water is taken at Indian Point from the water treatment plant supplying water to the secondary system or the heat exchangers.

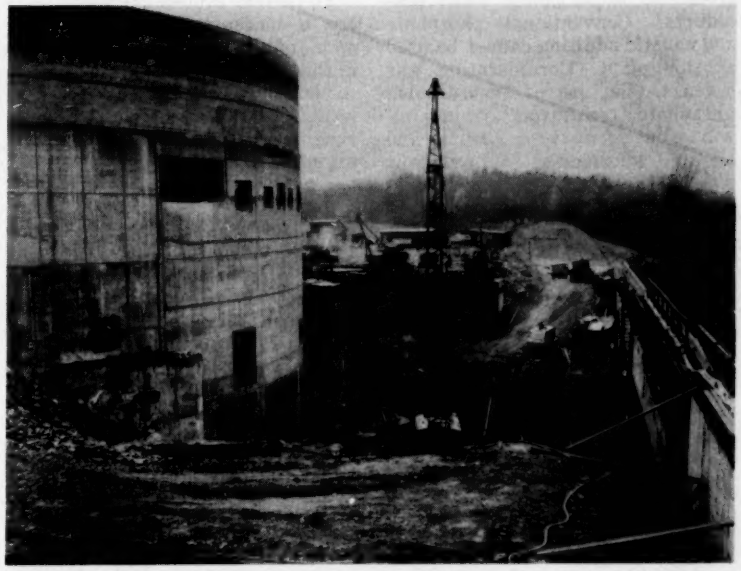
Raw water supply for Indian Point is part of the New York City water supply system, and is relatively pure. Raw water is softened by going through four cation resin units which exchange hydrogen ion for the various cations in the water. Effluent water from this softening plant then goes through a wood stave decarbonator in which carbon dioxide is reduced to about a 5 ppm. level in the outlet by blowing with air. The decarbonator effluent water is brought to a pH of 8.5 by addition of sodium hydroxide and then evaporated.

The evaporators have cupronickel tubes, are heated by steam from a turbine bleed point, and are preceded by a degasifier section to reduce dissolved gas content. Total dissolved solids content in the evaporator will be kept at less than 1,000 ppm. Steam overhead should have an electrical conductivity of less than 1 micromho, or a total dissolved solids content of less than 0.25 ppm.

Evaporator overhead is further purified by passage through a mixed bed resin ion exchanger. The final water should have less than 0.05 ppm. of total dissolved solids, and is the feedwater for the primary loop system and also the secondary system in the heat exchangers.

### Secondary System Purity

Since the heat exchangers have Type 304 stainless steel tube sheets and tubes (carrying the hot primary water) and a carbon steel shell for the heat exchanger and steam drum, purity required for the secondary system or boiler water is quite high. Both laboratory tests and plant experience have indicated that this stainless steel can be stress cracked within a number of hours if the liquid in contact contains dissolved oxygen or chloride ion. High free alkalinity is also undesirable since it contributes to stress cracking. Specifications for the boiler water are: 100 ppm. maximum for total dissolved solids, 0.1 ppm. sodium chloride normal with a maximum limit of 1.0 ppm. and 0.007 ppm. maximum dissolved oxygen in the feed water.



**INDIAN POINT reactor, under construction, will be completed in 1961.**

Since it is proposed to operate with a 1% blowdown in the boiler system, the feedwater to the boilers must have a normal sodium chloride concentration of only 0.001 ppm. and a maximum of 0.01 ppm. This is a difficult enough specification with a city water feed, but it's almost impossible to achieve if the turbine condenser leaks Hudson River water into the steam condensate. The Hudson River at Indian Point is within the tidal range, and depending on the time of the year, tide and wind, the sodium chloride content has been found to be as high as 3,000 ppm., although it is about 10-20 ppm. for most of the year. While the turbine condenser is a special design where admiralty metal tubes are welded into the silicon bronze tube sheets, there is still a possibility of salt leakage into steam condensate.

Detecting condenser leakage at this chloride level is quite difficult, especially since it is desired to have an automatic plant instrument on the line around the clock to monitor the condensate purity. Indian Point proposes to use a flame photometer developed in the Con Edison laboratories. Water samples are injected into an oxy-hydrogen flame and the intensity of the sodium line measured by a dispersion grating and phototube. This instrument is capable of determining sodium in the parts-per-billion range. Since the sodium/chloride ratio in the Hudson River water is fairly constant, averaging about 1.50, this sodium determination gives a good indication of chloride concentration.

It is proposed to have a number of these flame photometers monitoring the turbine condensate, with provision for shutting down quadrants of the condenser in the event of high sodium, indicating a river water leak into the system.

### Avoid Stress Cracking

Since presence of free alkali accelerates stress cracking of stainless steel, chemical conditioning of the boiler water must be different

from the usual power plant procedures. Conventional phosphate and caustic addition cannot be used at this plant. Consideration was given to the use of "coordinated phosphate treatment" which involves use of mixtures of acid and alkaline phosphates to produce a water with a fairly high pH, about 10-11, 50-100 ppm. of phosphates, and no free alkali.

Control of such boiler water conditioning would be difficult at Indian Point, particularly since amount of liquid water in the boilers per unit of steam produced is extremely small. The benefits which could be obtained from use of phosphate did not appear to warrant the effort required to insure absence of free alkali at all times in the boiler water.

It was therefore decided to operate these boilers with zero solids treatment. No solid compounds are used for the boiler water conditioning. Boiler water pH is maintained at about 9.0 by addition of cyclohexylamine after the condenser hotwell pumps. This amine is volatile and will produce alkalinity not only in the boiler water but in the steam condensate, feedwater heaters, pumps, etc., and corrosion in the entire secondary system should be minimized. Addition of the amine will be automatic and actuated by a continuous pH cell in the condensate line.

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Dr. Stolzenbach holds chemical engineering degrees from Cooper Union and Columbia University. He is a licensed PE (N.Y.) and is presently an adjunct professor at Brooklyn Polytechnic.

To further protect the steam boilers, a concentration of 0.1 to 0.2 ppm. of hydrazine is maintained in the feedwater (added just before the boiler feed pump, after the feed water deaerating heater). Experience in other stations indicate that oxygen content in the boiler should be about zero.

### Handling Leakage Wastes

Operation of a reactor produces radioactive liquid wastes by leakage from the system, draining and rinsing of units taken out of service for repair or maintenance, filter backwashings, ion exchange resin transfers, safety valve blows, chemical laboratory drains, sample drains, etc. None of these may be discharged to the river or atmosphere without at least testing to indicate that the legal limits of permissible concentrations of radioactive isotopes are not exceeded. Every possible discharge of liquid or gaseous wastes from the plant must be monitored and controlled.

The Indian Point plant will have no facilities for permanent storage of radioactive material; all of the wastes will be concentrated and transferred out of the plant for ocean burial, or so diluted that they can be freely discharged (see Fig. 3).

The liquid wastes at Indian Point are stored in four 10,000 cu. ft. stainless steel tanks for several months to decay the short lived radioisotopes, and then evaporated. An Inconel evaporator has been designed to produce a practically carry-over-free distillate: the distillate will have less than 0.05 ppm. of total dissolved solids. This separation requires a very efficient demister to remove liquid droplets from the distillate vapor. This evaporator will have a low vapor velocity and about a 3-ft. depth of stainless-wire-mesh demister.

Distillate is further polished by passage through a mixed-resin ion exchanger. Final product will have less than 0.01 ppm. of dissolved solids and the radioactivity will be less than $1 \times 10^{-8}$ microcurie/ml. (the maximum permissible concentration for liquid plant wastes). This distillate can be reused in the plant as makeup water, or can be discharged to the Hudson River after dilution with the turbine condenser cooling water.

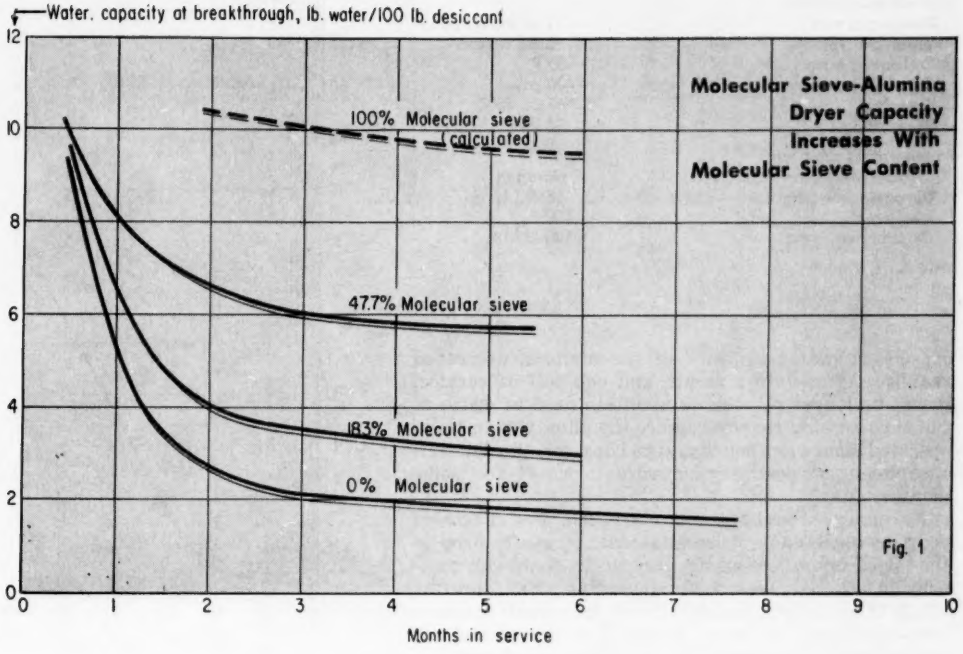
Evaporator bottoms have a solids concentration of about 30% by weight, and should not have any crystallized salts. This is handled by mixing with portland cement and casting into steel drums. These drums will be finally disposed of by dumping into an appropriate area in the Atlantic Ocean.

The various ion exchangers in the blowdown purification system and liquid wastes systems are not regenerated: volume of waste-regeneration solutions will be considerably greater than volume of fouled resins. The fouled resins will be sluiced hydraulically out of the ion exchanger cases into waste-resin storage tanks and allowed to decay for about six months. Waste resins will then be mixed with portland cement and water and cast into steel drums. These will be dumped into the ocean with the other liquid waste concreted drums.

### Not Permanent Solution

Note that waste disposal at Indian Point does not produce a permanent solution to the waste disposal problem, but merely removes the radioactive wastes from the plant and dumps them into the ocean. This is one of the promising fields for the chemical engineer—to find a permanent method of safe disposal of high-level radioactive wastes. A considerable amount of work has been done at a number of the AEC reactor sites and laboratories to dispose of wastes by mixing with various silicates and firing to produce a nonsoluble and nonleachable glass. This glass could then be readily disposed of by either ocean or ground burial. None of these processes are as yet in a commercial stage, but some better method of disposal must be developed before the atomic power industry comes to maturity or its growth will be limited by the amount of wastes which can be safely dumped into the ocean.

It is also entirely possible that useful radioisotopes can be separated from the atomic power plant wastes. Such a method offers a good means of disposal of the wastes and also would reduce costs of waste disposal to the point that a net return might be obtained from the radioactive wastes. This form of disposal suffers at the moment: an insufficient market for radioisotopes and insufficient supply of nuclear power plant wastes.




# Molecular Sieves for Gas Drying

**Here's a case study how Sun Oil found molecular sieves superior to other desiccants for drying refinery off-gases. It's a technique applicable to all gas drying problems.**

**G. S. COCHRANE, Research and Engineering Dept., Sun Oil Co., Philadelphia, Pa.**

EFFECTIVE drying is an essential process step when hydrogen-rich off-gas from platinum reformers is used as a raw material for anhydrous ammonia. In this process, the off-gas is dried and hydyrocarbons removed by low-temperature condensation and liquid-nitrogen scrubbing in a cold box.

Without adequate drying, water or hydrates freeze in the low-temperature equipment and cause poor heat transfer and increased pressure drop.

Ordinary techniques using activated alumina are not suitable for drying this reformer off-gas. At Sun Oil's $NH_3$ plant in Marcus Hook, Pa., the presence of 10 to 20 mole % of hydrocarbons, including aromatics, substantially reduces the water capacity of alumina. Thus, it is an unsatisfactory desiccant for use in this service.

## How Original Dryers Operated

At Sun Oil, two hydrogen dryers are used. Throughput is about 25 million scf./day at 400 psig. and 60 F. (Table I). The dryers were designed for a 4.5 wt. % water loading on activated alumina and with an effluent dew point of 90 F.

Dryers must be periodically regenerated by heating to about 380-390 F. with hot nitrogen. Warming and cooling during the regeneration cycle require 8 hr. so the alternate dryer must remain in service during that time without a water breakthrough. When breakthrough occurs in less than 8 hr., the useful life of the desiccant has been reached.

Initially, the hydrogen dryers were charged with activated alumina. During the first several months

**How Original Dryer Ran—Table I**

| | |
|---|---|
| **Operating conditions** | |
| Design gas rate | 25 million scf./day |
| Superficial velocity | 0.65 ft./sec. |
| Operating temp. | 60 F. |
| Operating pressure | 400 psig. |
| Dryer vol. | 157 cu. ft. |
| Dryer dia. | 54 in. |
| **Regenerating conditions** | |
| Regeneration gas | Nitrogen |
| Nitrogen dew point | 65–95 F. |
| Inlet temp. | 420 F. |
| Outlet temp. max. | 380–390 F. |

of service, water capacity of the alumina decreased rapidly. After only a month and one-half of service, it was no longer possible to maintain an 8 hr. cycle at full throughput. However, since the plant was initially operated somewhat below design capacity, the deleterious effects of poor drying were tolerated for some months.

As plant throughput was increased, the effects of poor drying became more apparent. Pressure drop in the low-temperature exchangers in the hydrogen purification unit increased significantly, often limiting plant throughput. Cause of the increased pressure drop was traced to water freeze-up in the exchangers due to ineffective drying of the hydrogen off-gas.

Although the dryer design was thought adequate, based on experience in drying other gases, saturated and aromatic hydrocarbons in the off-gas substantially reduced the capacity of the alumina. Result: poor drying.

Typical composition of the hydrogen-rich off-gas is given in Table II. This stream is the total off-gas from two reformers. One reformer produces high-octane gasoline from light naphtha; the other, aromatics from straight-run gasoline.

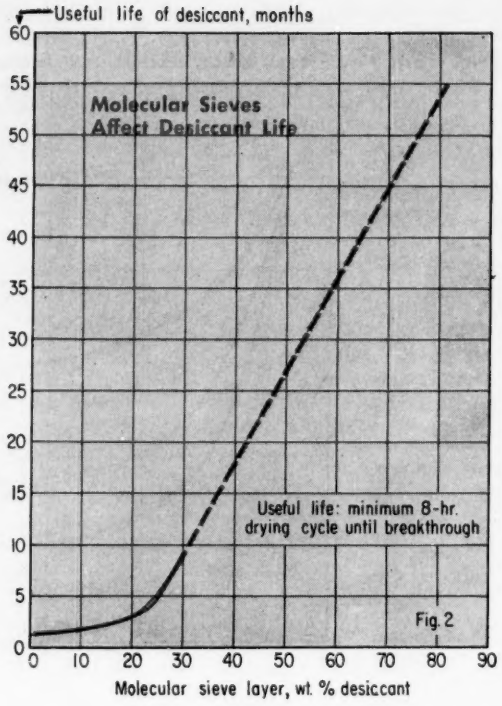
Some of the heavier hydrocarbons, especially the aromatics, in the hydrogen stream are readily adsorbed with the water by the alumina in the dryer. (See Table III.) As drying proceeds, additional water is adsorbed by displacing some of the hydrocarbons.

## What's Wrong With Alumina?

Low capacity of the alumina is the combined result of two effects. One is the reduced rate of adsorption; the other is reduced equilibrium water capacity.

Since the hydrocarbons must be desorbed before water is adsorbed, the rate of water adsorption is slowed down, resulting in a lower capacity under dynamic conditions. This effect is probably small since changes in gas velocity have very little effect on capacity.

Predominant effect is reduced equilibrium or pseudo-equilibrium water capacity due to the presence of hydrocarbons. Cause of this reduction in equilibrium isn't understood. However, it appears it isn't entirely due to polymerization of hydrocarbons on the alumina since there are less than 0.1% unsaturates in the feed gas. In addition, total carbon remaining on a regenerated sample of alumina that had been in service 6 mo. was only about 7 wt. %.


Useful life of desiccant, months
Molecular Sieves Affect Desiccant Life
Useful life: minimum 8-hr. drying cycle until breakthrough
Fig. 2
Molecular sieve layer, wt. % desiccant

Laboratory studies substantiate the large loss of equilibrium water capacity of used alumina. After 6-mo. service, the equilibrium water capacity at 23 mm. Hg decreased more than 60% compared with fresh alumina. Loss in equilibrium water capacity for molecular sieves after the same service was only 13%. (See Table IV.)

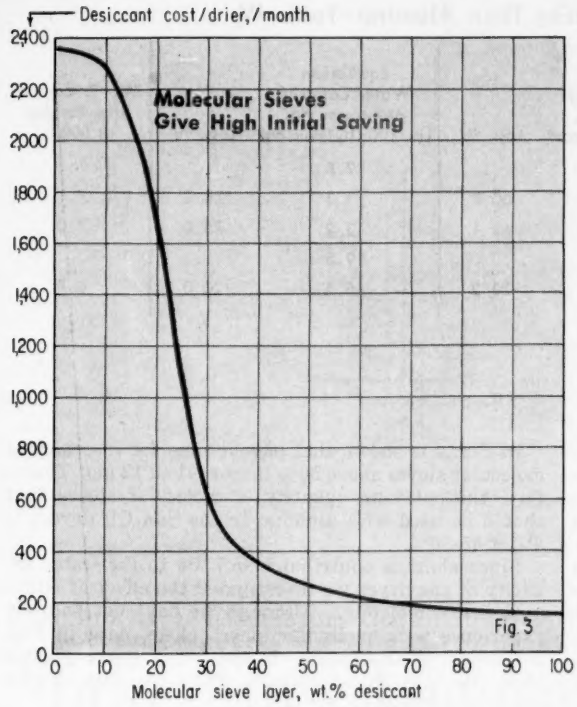
## Enter: Molecular Sieves

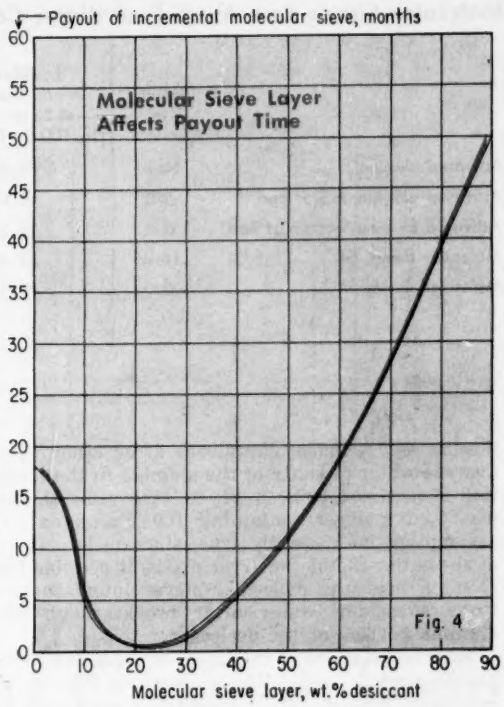
Since adsorption of hydrocarbons on alumina is the root of the problem, we decided to try molecular sieves. Unlike other adsorbents, molecular sieves have precisely uniform pore sizes, allowing them to adsorb cer-

**Composition of Reformer Off-Gas—Table II**

| Component | Mole % | Wt. % |
|---|---|---|
| $H_2$ | 84.0 | 22.4 |
| $C_1$ | 5.7 | 12.5 |
| $C_2$ | 4.3 | 17.6 |
| $C_3$ | 3.1 | 18.6 |
| $C_4$ | 1.6 | 12.7 |
| $C_5$ | 0.4 | 3.9 |
| $C_{6+}$ | 0.9 | 12.3 |
| | 100.0 | 100.0 |

About 15% of the $C_{6+}$ hydrocarbons are aromatics. Total unsaturates in gas is about 0.1 mole %. Off-gas is saturated with water vapor at 400 psig. and 60 F.




tain size molecules while completely rejecting other larger molecules. They are ideally suited for adsorbing water while rejecting aromatics, branch-chained and other large hydrocarbon molecules.

At the outlet-end of one of the dryers, a 2-ft. layer of activated alumina was replaced with molecular sieves (18 wt. % of total desiccant). Alumina in the top 8 ft. of the bed was replaced with a load of fresh alumina.

This layer of molecular sieves increased the useful life of the desiccant combination from 1½ to about 2½ mo. Although this desiccant life was still unsatisfactory, there was enough improvement to suggest a larger molecular sieves layer might be the answer.

Two subsequent dryer fillings, containing 41 and 48 wt. % molecular sieves with alumina, are still performing satisfactorily after more than one year of service.

Average water capacities of three dryer fillings containing various percentages of molecular sieves and alumina, and how they decrease with age, are shown in Fig. 1. Data were obtained by using an electrolytic water analyzer to determine when the breakthrough occurred and by calculating the desiccant capacity from the equilibrium water content of the gas to the dryer.

Shape of all three curves is very similar. For the first few months, dryer capacity drops rapidly; then, following a break in the curves, the capacity continues to decrease at a slow rate.

Increase in capacity is almost directly proportional to the percentage of molecular sieves used.

Also shown is an estimated capacity curve for 100% molecular sieves. This curve was calculated assuming the average quantity of water adsorbed by alumina is not significantly increased by the layer of molecular sieves at the outlet-end of the dryer.

For example, in calculating the water capacity of the molecular sieves in the desiccant combination con-

**Hydrocarbons Adsorbed on Alumina—Table III**

| Paraffins | Liquid Vol., % | |
|---|---|---|
| $C_3$ | 0.2 | |
| $iC_4$ | 0.8 | |
| $nC_4$ | 1.5 | |
| $iC_5$ | 4.2 | |
| $nC_5$ | 2.6 | |
| $C_6$ | 35.4 | |
| $C_7$ | 17.6 | |
| $C_8$ | 3.2 | |
| $C_9$ | 1.4 | |
| | | 66.9 |
| Cycloparaffins | | |
| mono cyclo | 6.4 | |
| di cyclo | 0.2 | |
| | | 6.6 |
| Aromatics | | |
| $C_6$ | 13.1 | |
| $C_7$ | 9.9 | |
| $C_8$ | 3.1 | |
| $C_9$ | 0.4 | |
| | | 26.5 |
| | | 100.0 |

**Molecular Sieves Lose Much Less Water Capacity Than Alumina—Table IV**

| | Months in Service | Equilibrium Water Capacity at 23 mm. Hg, Lb./100 Lb. Desiccant | Loss, % | Equilibrium Water Capacity at 4.6 mm. Hg, Lb./100 Lb. Desiccant | Loss, % | Wt. % Carbon After Purging at 600 F. |
|---|---|---|---|---|---|---|
| Activated alumina | New | 43.0 | .... | 12.8 | .... | ... |
| Activated alumina, top of bed | 6.0 | 16.9 | 60.7 | 3.3 | 74.2 | 7.1 |
| Activated alumina, bottom of bed | 6.0 | 16.3 | 62.1 | 3.2 | 75.0 | 7.0 |
| Molecular sieves, 5A | New | 22.0 | .... | 19.5 | .... | ... |
| Molecular sieves, 5A | 6.0 | 19.1 | 13.2 | 15.6 | 20.0 | 3.7 |

taining 47.7% molecular sieves after 3-mo. service: average water capacity of the alumina in the combination is assumed to be 2 wt. % (the same as the capacity of a dryer containing 100% alumina). This assumption isn't strictly true, since molecular sieves at the outlet-end of the dryer makes it possible for the alumina near the molecular sieves interface to continue adsorbing water after breakthrough of the alumina portion of the desiccant.

Effect of the size of the layer of molecular sieves on the desiccant's useful life is shown in Fig. 2. Using less than 20% molecular sieves has very little effect on the useful life. However, above 20-25% molecular sieves, useful life is increased appreciably. Useful life of the dryer filled with 100% molecular sieves should be more than 3 yr.

### Find the Optimum Combination

Although increasing the percentage of molecular sieves used with alumina always increases the life of the desiccant, filling the dryer with nearly all molecular sieves isn't justified.

Effect of molecular sieves on monthly desiccant cost is shown in Fig. 3. Increasing the percentage of molecular sieves up to about 40 or 50% sharply reduces desiccant costs. Above 50 or 60%, however, savings from the use of additional molecular sieves are very small.

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In Fig. 4 is shown that payout time for incremental molecular sieves above 50% is more than 12 mo. Therefore, the optimum quantity of molecular sieves that should be used with alumina in the Sun Oil dryers is about 45-50%.

Since alumina contributes so little to the water capacity of the dryer we investigated the effect of eliminating it completely. Although we have not had any experience with molecular sieves alone, data in Fig. 1 indicate their capacity is about five times greater than the capacity of alumina while the cost is only about four times as much.

Therefore, the lowest desiccant cost for this service is obtained by eliminating alumina and using only molecular sieves. In addition, replacing alumina with one-fifth the weight of molecular sieves gives the same capacity, but cuts regeneration costs by reducing the quantity of desiccant that must be repeatedly heated up and cooled down.

As in the previous case, using too much molecular sieves isn't economical. For the existing Sun Oil dryers, optimum loading for molecular sieves alone is about 50-60% of the dryer volume. For similar drying problems at other conditions, optimum dryer capacities would, obviously, be different.

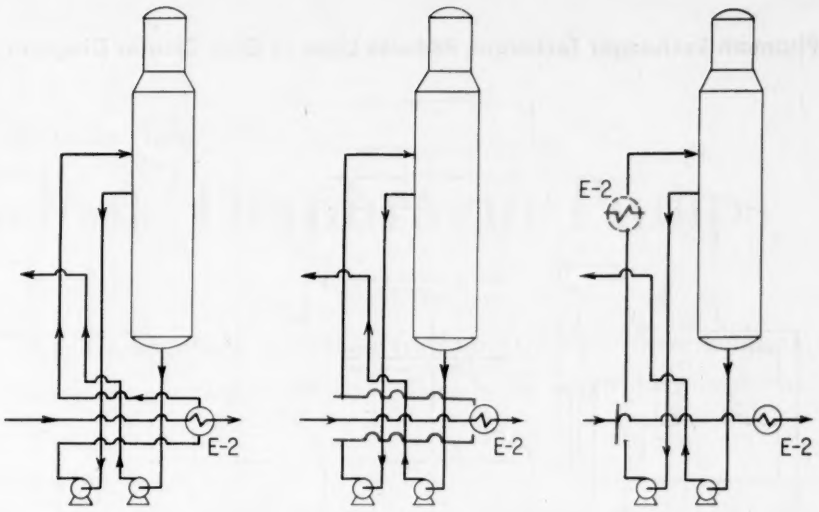
### Advantages Are Obvious

Although molecular sieves greatly increase the capacity of the dryers, they have almost no effect on the dew point of the effluent gas. Water content of the effluent gas, as determined by an electrolytic water analyzer, is less than 10 ppm.

Regenerating the molecular sieves to a higher temperature or with a drier nitrogen purge gas would, undoubtedly, reduce the effluent water content. However, this isn't possible on the dryers at the Sun Oil installation.

The drying problem we described is a rather special case since the size of the dryers was already fixed. However, the value of considering molecular sieves when designing a drying system for a similar service is obvious. Not only will the dryers and regeneration equipment be smaller, but operating costs and desiccant cost will also be less.

Molecular sieves have proved superior to other desiccants where interference from aromatic and other hydrocarbons in the gas stream is a problem.




### Phantom Heat Exchangers Require Fewer Lines

# Make Flow Diagrams Easier to Read

**For easier comprehension of process flowsheets, minimize overlapping lines by adding duplicate exchangers near effluent streams which provide the necessary heat.**

**SY H. FRIEDMAN and H. R. GARRISON, Bechtel Associates, New York, N. Y.**

IN MODERN oil refineries or chemical process plants, the trend is toward higher temperatures and better over-all thermal efficiency. Both result in more extensive use of shell-and-tube heat exchangers. Flowsheets for these units can become extremely complex. This is particularly true where a main feed stream picks up heat by exchange with a number of product streams; or a hot reactor effluent stream provides heat to a number of services such as column reboilers.

Drawing these additional heat exchange streams can easily obfuscate the clear presentation of what is actually being processed. This is particularly true if we are studying a flow diagram of a new or unfamiliar process.

If we use a phantom heat exchanger which is defined as the second drawing of the same heat exchanger, the line arrangement can be greatly reduced. Illustrated on this page is a section of a fictitious process flow diagram before and after the use of phantom heat exchangers. Flow streams from other equipment unnecessarily complicate an already complex flow diagram.

An example of a flow diagram is presented for comparison of the two methods, one using the phantom exchanger idea and the other a conventional representation. The example shows a simple two-stage crude distillation unit, but it serves to illustrate utility of the method. Not using the phantom technique for the heat exchange train of E-1, E-2, E-3, E-4, E-5 and E-6, requires the additional lines shown in color. With the use of the phantom heat exchanger a much clearer presentation of the flows is possible.

To see how the integrity of the flow diagram is retained and yet simplification is made, turn the page and see how a typical petroleum refining flowsheet is made easier to read when the phantom heat exchanger is used.

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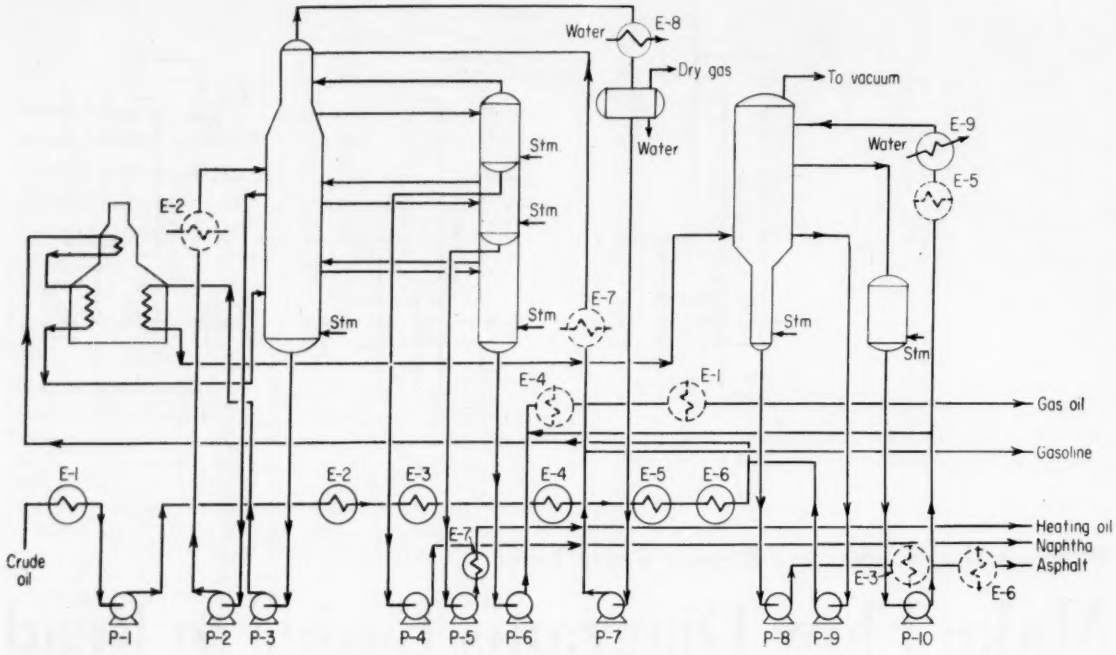
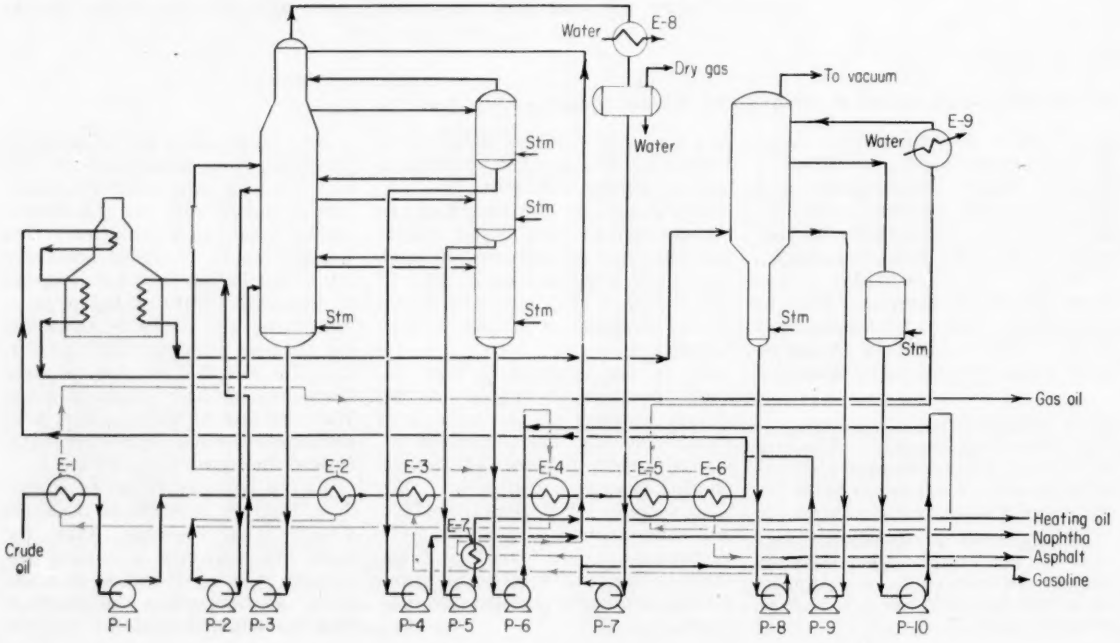
## Phantom Exchanger Technique Reduces Lines to Give Clearer Diagram




## Conventional Representation of Flow Diagram Requires Many Lines

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For handling difficult materials . . .

# Don't Overlook Diaphragm Pumps

**Diaphragm pumps solve your transfer problems when handling abrasive slurries, corrosive liquids or delicate materials.**

CARL JAHREIS, T. Shriver & Co., Inc., Harrison, N. J.

DIAPHRAGM pumps provide a simple and efficient means of pumping the hard-to-handle liquids and slurries. In its simplest form, a diaphragm pump may be likened to a piston pump in which the piston is replaced by a pulsating diaphragm. By this one change we eliminate the need for all rotating or sliding packings in contact with the liquid being pumped. The only moving parts in contact with the liquid are the diaphragm and the valves.

Advances in recent years in elastomer research have considerably reduced former limitations placed on these pumps by the diaphragm material. Elimination of packings and close clearances within the pump immediately point up two of the most important uses of the diaphragm pump:

1. Pumping abrasive and corrosive materials.
2. Pumping delicate materials.

In the first category, we find such materials as metallurgical sludges, clay, pigments, paints and waste disposal slurries. In the second category, we find such sensitive materials as rubber and plastic latexes and slurries where it is necessary to maintain a definite crystal structure. Another important use of diaphragm pumps is as proportioning devices.

## Method of Motion Types Pump

Diaphragm pumps may be conveniently classified by the manner in which the pulsating motion is transmitted to the diaphragm. Normally this motion is derived from hydraulic, mechanical or pneumatic action.

A hydraulically actuated diaphragm pump consists of a reciprocating piston whose motion is transmitted through a hydraulic fluid to the diaphragm. Pressure on both sides of the diaphragm is balanced with the diaphragm carrying no load but acting as a pressure exchanger as shown in Fig. 1. This type of construction is generally favored for smaller diaphragm pumps used for proportioning. It is generally not used for larger size pumps because the hydraulic fluid tends to overheat.

Provision must be made in the hydraulically actuated pump to replace any fluid lost by leakage from the actuating system, or else the pump will gradually lose capacity. Circulation of the oil must be provided to prevent the oil from becoming overheated by its continual compression and decompression.

In a pump of this type the displacement of the diaphragm is equal to the displacement of the actuating pump. Hence the discharge characteristics of the two pumps are the same. Hydraulically actuated diaphragm pumps operate at pressures up to 1,000 psi. and in capacities over 100 gpm.

Mechanically actuated diaphragm pumps may be further classified as:

1. Pumps with mechanically supported diaphragms.
2. Pumps with unsupported diaphragms.

In the mechanically actuated diaphragm pump, the pulsating motion is transmitted by direct mechanical means to the diaphragm. In Figs. 2 and 3, two methods are shown of transmitting this motion to the diaphragm. Pumps of this type have been made in sizes ranging from a fraction of a gallon per minute to over 100 gpm. and for pressures up to 500 psi.

Smaller sizes of diaphragm pumps find some use in the proportioning field. Larger sizes are used mainly for transfer work and filter press feed.

Unsupported mechanically actuated diaphragm pumps are probably better known for their use in handling dirty water and sewage sludge in construction and sanitary work. A cross-section of this type is shown in Fig. 4. Use of this type is limited by the relatively low head that can be developed without failure of the diaphragm. In chemical processing, their use is largely in the handling of thickener underflow and in metallurgical flotation work.

Pneumatically operated diaphragm pumps are the simplest of the diaphragm pump types. This pump consists of a split shell with a separating diaphragm as shown in Fig. 5. Air is alternately admitted and vented from the top half by time-controlled solenoid valves to give a pulsating motion to the diaphragm. These pumps must be operated with either a positive suction head to assure the return of the diaphragm at the end of the pressure stroke, or a vacuum system must be provided to supply sufficient vacuum to return the diaphragm.

Pump capacity is a function of the air pressure and liquid pumping pressure. Unlike the hydraulically and mechanically operated diaphragm pumps whose output resembles that of a piston-type pump, the pneumatically operated dia-

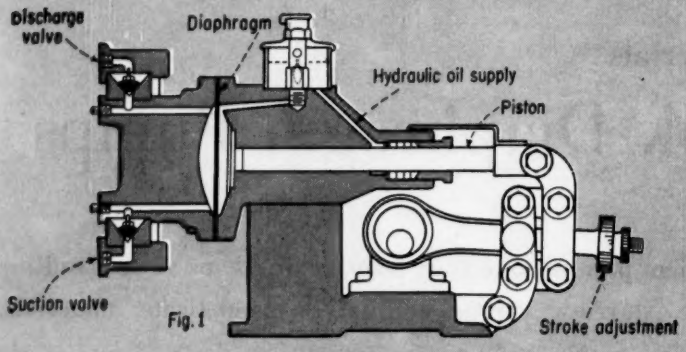



Fig. 1 Hydraulically Operated Diaphragm Pump

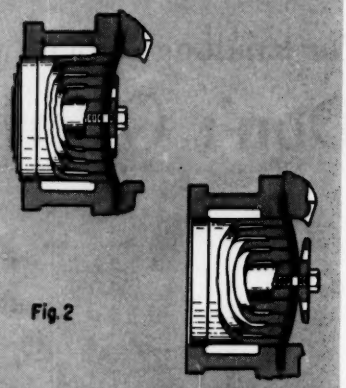


Fig. 2 Concentric Ring Pistons Support Diaphragm

phragm pump when operated at constant air pressure shows a drop-off in capacity with increasing pumping pressure. It will no longer deliver liquid when the liquid pressure reaches the pressure of the applied air.

### Consider Diaphragm Material

An elastomeric material usually molded into a cupped or disk shape forms the diaphragm for these pumps. Flat sheets of material sometimes replace the molded type. Depending upon the nature of the diaphragm material and the service to which it may be subjected, it may or may not contain fabric reinforcement.

Selection of diaphragm material is the key to successful low maintenance operation. In small pumps used for metering, the ratio of the displacement of the diaphragm center to the diameter of the diaphragm is low. Hence, much stiffer materials may be used than is the case for the larger pumps.

In addition to natural rubber, almost any elastomeric material may be used for the diaphragm. The common synthetics such as Neoprene and Hycar find considerable use, particularly in non-aqueous base liquids. Plasticized polyvinyl chloride shows good resistance to many chemicals but in some cases the life of such material may be limited by the tendency for the plasticizer to leach out. This results in hardening of the material. Materials such as chlorosulfonated polyethylenes show good oxidation resistance, although polyurethane plastics offer some degree of higher temperature resistance. Silicone rubbers, although offering a high degree of temperature resistance, have not performed too well due to their relatively low tear resistance and strength. The nitrile rubbers appear to offer some possibility of raising the operating temperature of these pumps.

In addition to the true elastomeric plastics, stiffer materials such as the fluoro- and fluorochlorocarbons have been used in conjunction with rubber or synthetic rubber backup diaphragms. Fluorochlorocarbons have the advantage that they may be plasticized for better flexibility, but at the expense of temperature resistance. These materials offer the advantage of a nonsticking surface which is important for the handling of rubber and plastic latex.

### Liquid Ends and Valve Design

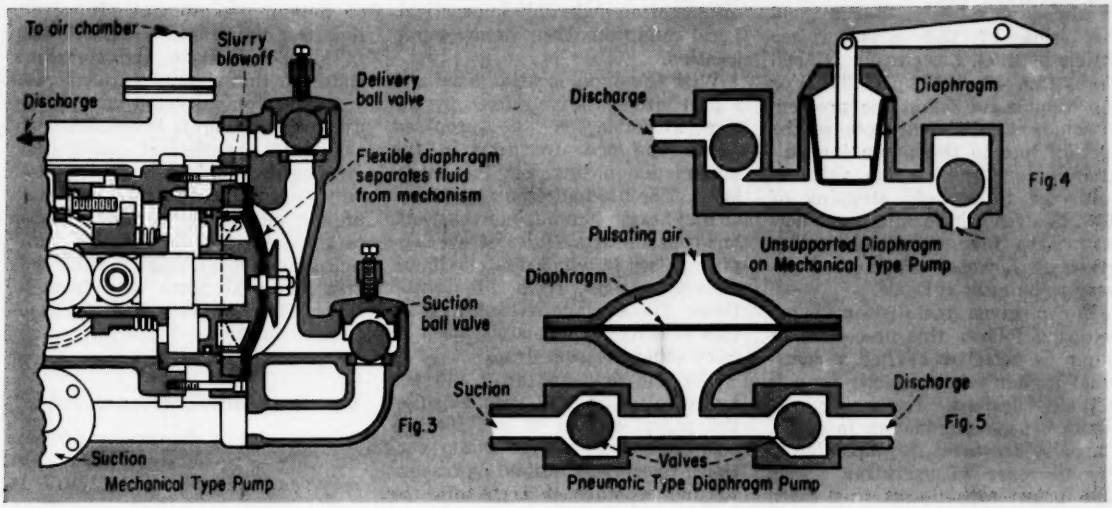
Liquid ends of a diaphragm pump refer to those parts of the pump other than the diaphragm that comes in contact with the liquid. Because diaphragm pump design seals off working parts of the pump from the liquid being pumped, the working parts do not require chemically resistant construction. Hence, liquid ends may be made of practically any material of construction, and the absence of close clearances makes them well-suited for coated construction.

In the larger sizes, aluminum, bronze, iron, lead and stainless steel are commonly used together with linings of various plastics, rubber and porcelain. In the small sizes, such as used for metering service, the above metals may be used with solid plastic ends of methacrylate or fluorocarbon in preference to lined construction.

Location of the inlet and outlet of the pumping chamber can affect pump performance. In general, an inlet at the bottom and outlet at the top of the pump insure self-priming and adequate venting of air. Where liquid contains quick settling solids, both the inlet and outlet may be located at the bottom. The settled solids are then automatically swept out.

However, with this arrangement of bottom inlet and outlet, the air in the pump at the start of the run may be merely compressed and re-expanded on the suction stroke. Hence the pump will not prime.

Depending upon the manufacturer's design, the suction and discharge valves may be an integral part of the pump head or may be located in the piping immediately adjacent to the pump. Gravity-type ball valves or flap valves are favored for this service because springs tend to clog with solids present in the liquid being pumped.




Larger sizes of pumps designed for slurry service are made with greater valve clearances and lift than are used on conventional reciprocating pumps. Balls are usually of rubber or synthetic rubber, metal-cored rubber or synthetic rubber, or metals such as bronze or stainless steel. Ball densities increase with increasing liquid density and viscosity.

### Flow Characteristics

Flow from a diaphragm pump is of pulsating nature that may be reduced to any desired extent. The air chamber consists of a closed chamber having a bottom connection to the liquid on the discharge side of the pump. Air in the chamber is alternately compressed and expanded to even out the fluctuations of the pump.

In the pneumatically operated pump, the timing mechanism can have two or more timing cams so that several pumps may be arranged in parallel. Pulses are set suitably out of phase so that the pulses overlap each other.

Similarly, two or more hydraulically operated diaphragm pumps may be arranged so as to be driven by a single source of power with the individual units again arranged out of phase. Mechanically operated diaphragms with mechanical support are by their nature normally made duplex in operation.

### Sizing the Pump

Size of a diaphragm pump refers to its pumping rate for water at a pressure of 10 to 20 psi. Unlike the centrifugal and turbine pumps, capacity of mechanically and hydraulically operated diaphragm pumps varies little with pressure.

Capacity ratings on the order of 90 to 95% are experienced at maximum operating pressure with operating efficiencies being in the 80 to 85% range based on the volumetric displacement of the pump. These efficiencies are lower than what is commonly obtained on reciprocating pumps due to the greater clearance provided in the valves of diaphragm pumps to permit handling of slurries containing considerable quantities of suspended solids. While these pumps show a somewhat lower volumetric efficiency on clear liquids, they are capable of handling slurries that would quickly clog valves in pumps designed for higher efficiencies.

One obvious rule of pumping is that a pump cannot deliver more material than is supplied to it. Once the material is supplied to the pump, we have available the full power of the driving motor to force this material out of the pump and on to its destination.

However, we must depend entirely upon atmospheric pressure plus any hydrostatic head on the pump suction to force the liquid from the feed tank into the pump. The rate at which material is supplied under the condition of minimum absolute pressure at the pump suction will determine maximum capacity of the pump.

From a practical standpoint, minimum absolute pressure that can be obtained at the pump suction will be determined by:

1. Absolute pressure at the pump suction cannot be less than the vapor pressure of the liquid at the pumping pressure. This factor is particularly important when handling liquids containing volatile components or liquids at elevated temperatures.

2. Inability of the diaphragm to draw back properly against low absolute pressure produced on the pump suction creates a serious condition which varies with the type of pump and diaphragm material.

As the diaphragm is drawn back on the suction stroke, the vacuum created in the pumping chamber tends to hold the diaphragm in the discharge position. This condition decreases pump capacity and diaphragm life. For mechanically operated diaphragm pumps, the condition can be relieved on operations pumping from a vacuum to a higher pressure by the simple expedient of connecting the mechanical working chamber of the pump back through a small line to the vacuum space above the liquid.

Maximum pipe size will be determined by the tendency of solids to settle out in the pipeline because

of low fluid velocity. For a good discussion of this problem see article by J. G. Lowenstein (*Chem. Eng.*, Jan. 12, 1959, p. 133). For the diaphragm pump the problem is somewhat different because the suction line to the pump immediately before the suction valve is subjected to periodic stopping of flow. Valves whose minimum flow is two to four times the values given by Lowenstein's method appear to be most suitable.

For a given installation, pump selection follows this procedure. A pump is selected having a somewhat higher rated capacity than is actually desired. Increasing viscosity causes a reduction in speed. Capacity decreases in proportion to the decrease in operating speed. The pump capacity at this speed represents a maximum obtainable condition under the best suction conditions. If the pump initially selected is of insufficient capacity, a larger size must be selected so that sufficient capacity is available at the reduced speed.

Tentative selection of the pump size will usually provide a possible selection of two or more pipe and passage sizes that can be obtained for any given pump. For best operation, a short suction line with positive head on the pump suction is preferred. However, plant conditions often make this impractical. Local conditions then dictate pump location.

With the pump location fixed and a pipe size tentatively fixed by the size available on the proposed pump, the pressure drop in the pump suction line may be calculated. The discharge on any piston or diaphragm pump is not constant, but consists of a series of overlapping pulses in which the maximum velocity ranges from 1.5 to 2.0 times the average velocity. It is this velocity that must be used in calculating pressure drop.

Use the pressure drop and the hydrostatic lift that may exist on the pump suction to get the absolute pressure at the pump suction. Check the absolute pressure to find whether it is within the limit recommended by the pump manufacturer for diaphragm life and possible cavitation.

If the pressure drop gives a dangerously low absolute pressure, a larger size pipe is necessary to reduce the pressure drop in the suction line. If the material being pumped contains solids subject to settling, the suction line must be further checked to assure a sufficiently high suction velocity to prevent settling.

Where these two factors cannot be reconciled, solution must be found in relocating the pump to reduce the suction line loss or of accepting a low absolute pressure at the pump suction with reduced diaphragm life. Under good conditions, viscosities of about 30,000 centipoises have been handled in pumps of this type.

Most diaphragm pumps may be subjected to two controls, control of the speed and control of the stroke. Where the latter can be obtained, it is the less expensive method of obtaining variable capacity operation.

CARL JAHREIS is director of the research and development division of T. Shriver & Co., Inc. He has been associated with the company since 1937 and has held positions in research, design and technical sales.

Mr. Jahreis has a B. Ch.E. from Rensselaer Polytechnic Institute and an M.S. in Ch. E. from New York University. He is a members of AIChE and of the Chemist's Club of New York.

## What Do They Cost?

Direct cost comparisons of the diaphragm type pump with other pumping equipment are difficult to make since pump designs, materials of construction and field of usefulness vary for each type of pump over the same capacity range. Depending on size, initial cost of diaphragm pumps ranges from $250 to $4,500. On the basis of initial cost per gpm., the diaphragm pump is one of the more expensive types of pumping equipment. However, it is the diaphragm pump's ability to handle abrasive and corrosive materials that shows its true worth.

Because only a small part of the diaphragm pump is in contact with the liquid, the effect of special alloy or plastic liquid ends is reflected only slightly in the increased cost of the pump. For example, in a large mechanically actuated diaphragm pump a change in construction material from cast iron to Type 316 stainless steel increases costs about 50%.

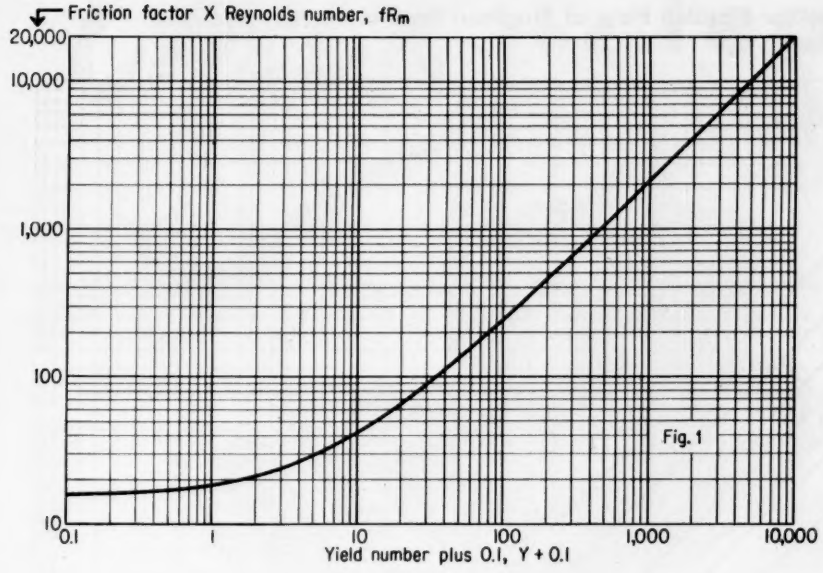
## Use Preventive Maintenance

Estimates of diaphragm life are difficult to generalize about. In most cases diaphragm failure is due to chemical attack leading to mechanical failure rather than flexural fatigue. Barring chemical attack, diaphragm life from six months to one year is not uncommon.

Annual maintenance costs average 3 to 6% of initial pump cost for pumps handling such diverse materials as ceramic glaze, clay slip, zinc sulfate and sulfite liquor. A high in annual replacement cost of 8% was reported for a pump handling sulfuric acid solution.

Low maintenance cost of the diaphragm pumps is due in part to the relative speed and ease with which diaphragms and valves may be changed. Valves on the Shriver diaphragm pump are changed by the simple removal of a yoke and cover. Removal of only six to ten nuts permits removal of the pump head for changing the diaphragm. With pump heads removed, the interior parts of the pump in contact with the liquid are readily accessible for examination and cleaning.

Successful operation of diaphragm pumps depends upon preventive maintenance to replace the diaphragms before actual failure. Various systems are used to detect diaphragm failure. A simple electrical conductivity element in the oil chamber of the pump can be arranged to stop the pump if the diaphragm ruptures. An internal seal between the oil chamber and the back of the diaphragm is also used to safeguard the pump mechanism in event of diaphragm failure. On some diaphragm pumps, bypass piping installed in back of the diaphragm discharges liquid outside the pump on diaphragm failure.




**Solutions for the Buckingham Equation—Table I**

| Yield Number, Y | Product, $fR_m$ |
|---|---|
| 0 | 16.00 |
| 1 | 18.67 |
| 2 | 21.32 |
| 3 | 23.97 |
| 5 | 29.20 |
| 10 | 41.94 |
| 20 | 66.42 |
| 30 | 90.09 |
| 50 | 136.1 |
| 100 | 247.5 |
| 200 | 463.8 |
| 300 | 676.4 |
| 500 | 1,096 |
| 1,000 | 2,133 |
| 2,000 | 4,186 |
| 3,000 | 6,226 |
| 5,000 | 10,290 |
| 10,000 | 20,407 |

## For laminar pipeline flow of Bingham plastics*. . .

# Use Chart to Find Friction Factors

**Graphical representation of the Buckingham equation in terms of a modified Reynolds number and yield number permits quick and accurate evaluation of the friction factors.**

**G. W. GOVIER, University of Alberta, Edmonton, Alta., Canada**

FOR LAMINAR flow of Bingham plastics in circular pipes, the Buckingham equation[1] is well established both theoretically and experimentally. The equation is most commonly written in the form:

$$\frac{8V}{D} = \frac{\tau_w g_c}{\eta}\left[1 - \frac{4}{3}\left(\frac{\tau_y}{\tau_w}\right) + \frac{1}{3}\left(\frac{\tau_y}{\tau_w}\right)^4\right] \qquad (1)$$

For shearing stress at the pipe wall, the relationship is:

$$\tau_w = D\Delta P/4L \qquad (2)$$

Combining Eqs. (1) and (2) gives an equivalent and more directly useful form.

$$\frac{8V}{D} = \frac{g_c}{\eta}\left[\frac{D\Delta P}{4L} - \frac{4\tau_y}{3} + \frac{1}{3}\frac{\tau_y^4}{\left(\frac{D\Delta P}{4L}\right)^3}\right] \qquad (3)$$

In Eq. (3), the pressure gradient $\Delta P/L$ is related to pipe diameter $D$, flow velocity $V$ and rheological properties $\eta$ and $\tau_y$. However, Eq. (3) is not easily solved for $\Delta P/L$.

### Consider Alternate Forms of the Equation

Expressing the Buckingham equation in several different forms permits a more direct solution for $\Delta P/L$.

(*Continued on p. 142*)

* Eugene Bingham, a physicist at the Bureau of Standards, while investigating the flow properties of paints, noticed their anomolous viscosity and postulated the "ideal" plastic. This is a substance, known today as a Bingham plastic, which acts as a solid until a certain stress is applied. At this yield value, the structure of the substance is entirely disrupted and it flows like a liquid. Kaolin slurries and sewage sludge are examples of Bingham plastics.

## Find Friction Factor for Laminar Pipeline Flow of Bingham Plastics

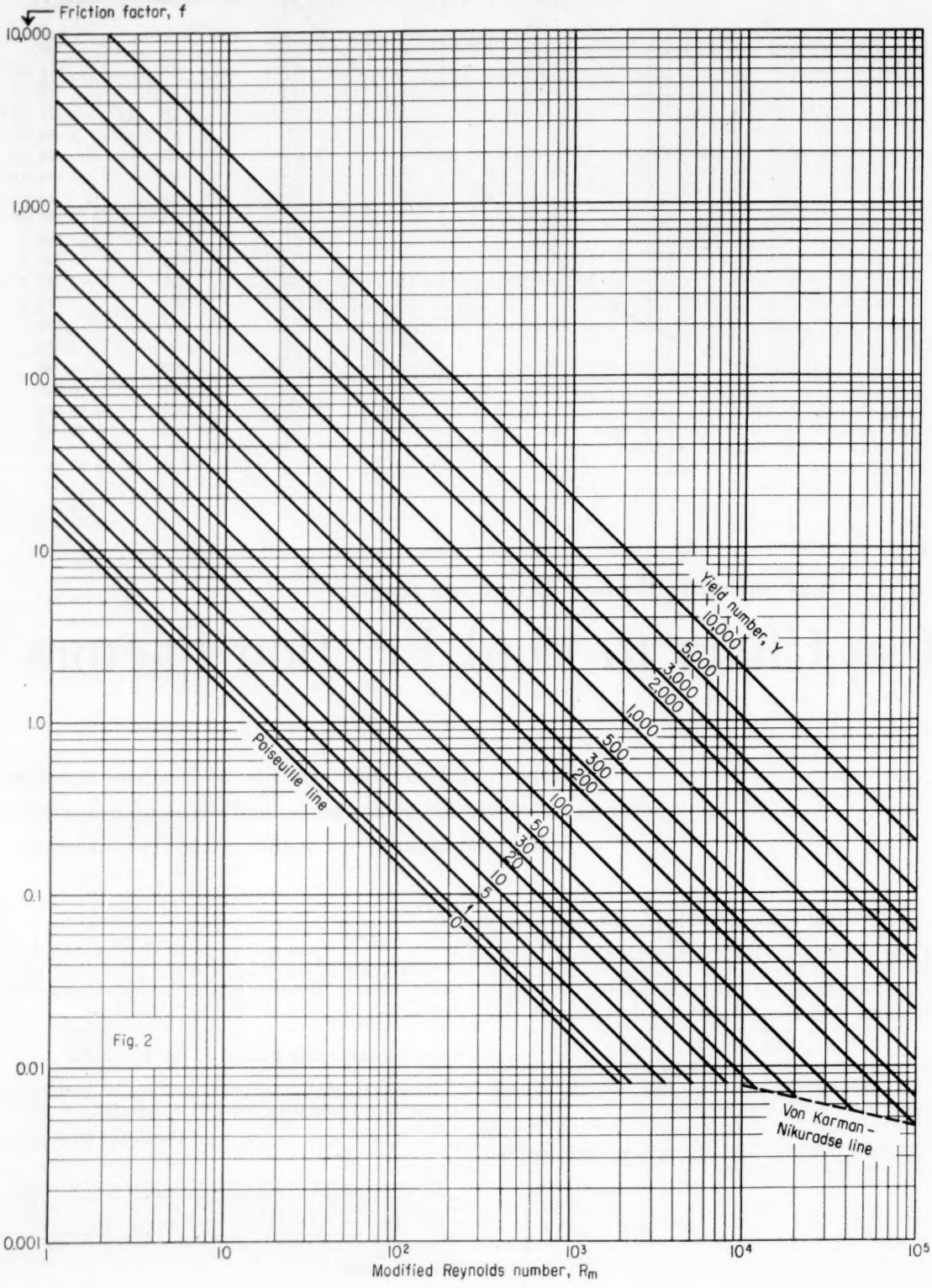



Fig. 2

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## Find Friction Factor for Laminar Pipeline Flow of Bingham Plastics

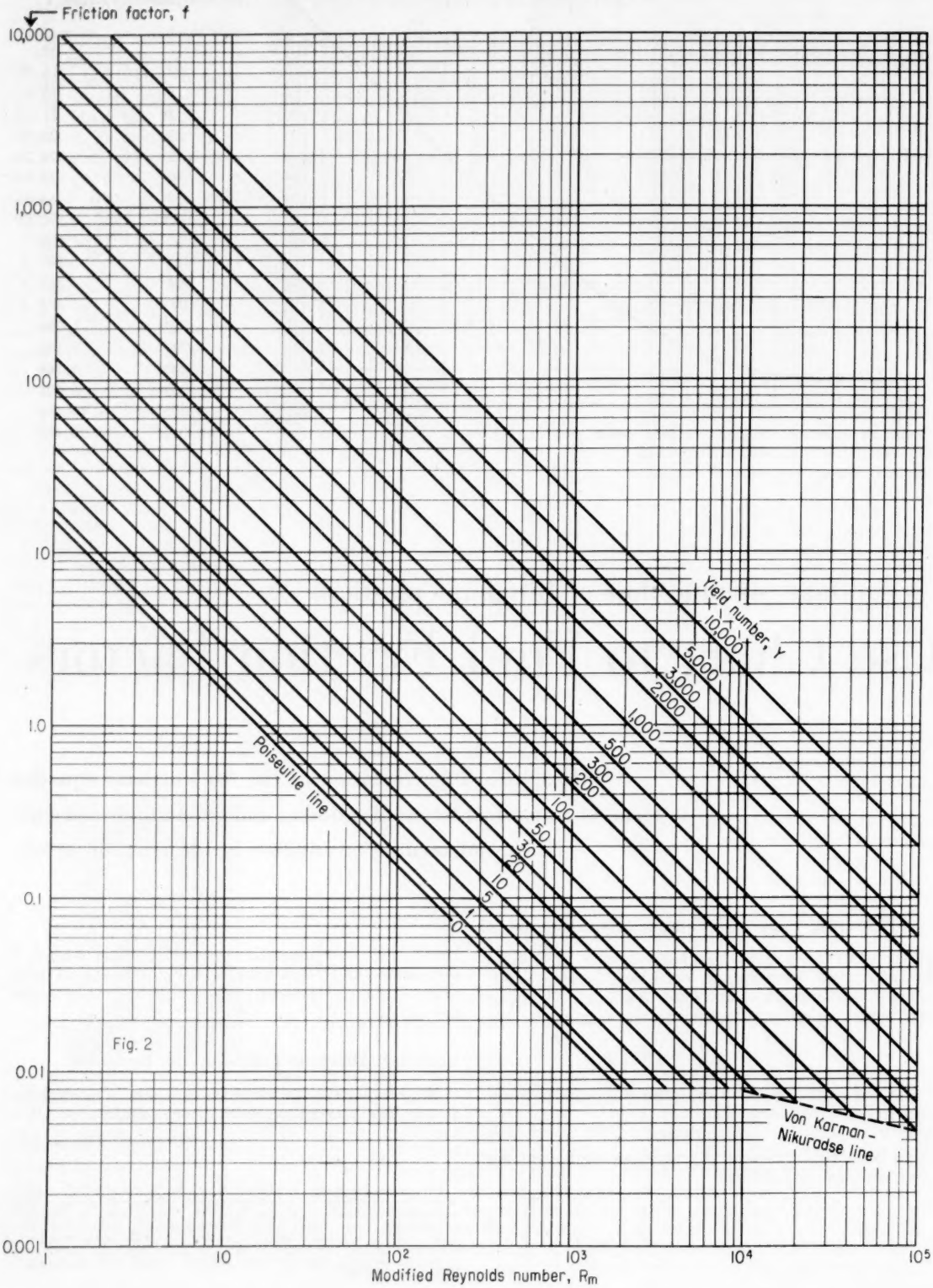


Fig. 2

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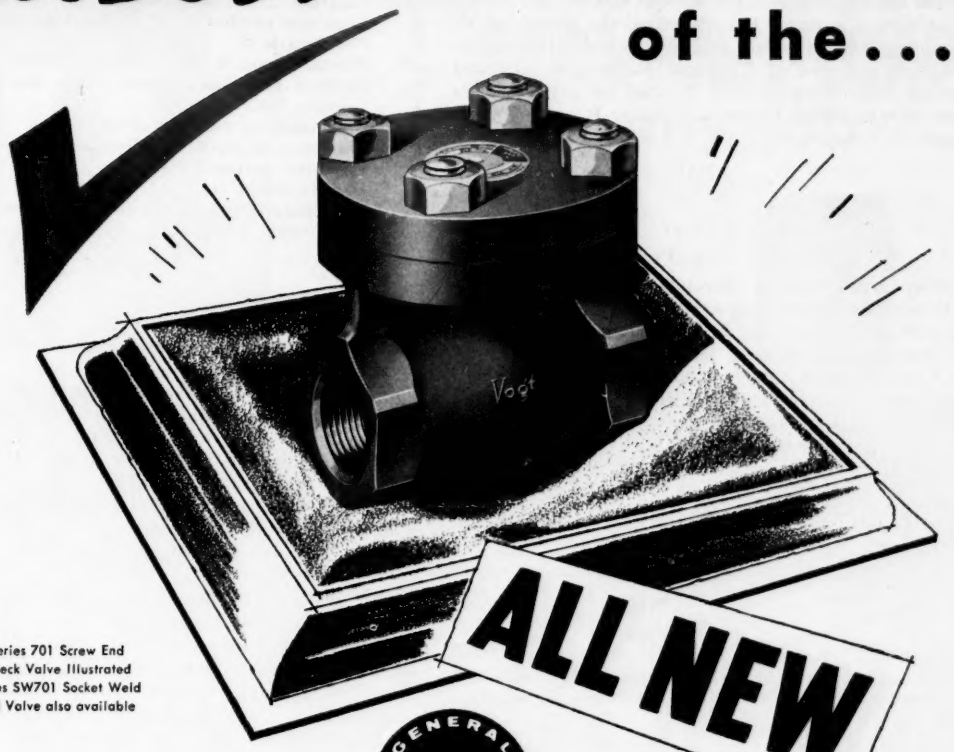


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(*Continued from p.* 139)

One of these is based on dimensional analysis of the flow of Bingham plastics and was first reported by Govier and Winning.[2] By accepting the definition of the conventional Fanning friction factor as being applicable to the flow of Bingham plastics, Govier and Winning demonstrated that $f$ could be expressed in terms of a modified Reynolds number $R_m$ and a yield number $Y$.

$$f = \frac{g_c D \Delta P}{2V^2 L \rho} \tag{4}$$

$$R_m = DV\rho/\eta \tag{5}$$

$$Y = D\tau_y g_c / V\eta \tag{6}$$

Govier and Winning correlated experimental data on the pipeline flow of clay-water slurries over a Reynolds number range of 10 to 150,000 in terms of these two dimensionless ratios. In the laminar flow range for $f$ values above about 0.008, their correlation is equivalent to the Buckingham equation.

Multiplying both sides of Eq. (3) by $\eta/8V^2\rho$ gives:

$$\frac{\eta}{DV\rho} = \frac{g_c}{8V^2\rho}\left[\frac{D\Delta P}{4L} - \frac{4\tau_y}{3} + \frac{1}{3}\frac{\tau_y^4}{\left(\frac{D\Delta P}{4L}\right)^3}\right] \tag{7}$$

$$= \frac{g_c D \Delta P}{32V^2\rho L} - \frac{\tau_y g_c}{6V^2\rho} + \frac{g_c \tau_y^4}{24V^2\rho\left(\frac{D\Delta P}{4L}\right)^3} \tag{8}$$

Substituting the dimensionless ratios of $R_m$, $f$ and $Y$ in Eq. (8) yields the friction-factor:Reynolds-number:yield-number form of the Buckingham equation.

$$\frac{1}{R_m} = \frac{f}{16} - \frac{Y}{6R_m} + \frac{Y^4}{3f^3 R_m^4} \tag{9}$$

If both sides of Eq. (9) are divided by $f$, the following equation is obtained:

$$\frac{1}{fR_m} = \frac{1}{16} - \frac{Y}{6fR_m} + \frac{Y^4}{3(fR_m)^4} \tag{10}$$

In Eq. (10), the product $fR_m$ is a unique function of $Y$, a fact pointed out by Hedstrom.[3] The quantity $fR_m$ is proportional to Hedstrom's factor $\phi(S)$ while $Y$ is proportional to his $S$.

From Eq. (10), we find that there is a linear relationship between logarithm of $f$ and logarithm of $R_m$ at any value of $Y$. On a logarithmic plot of $f$ versus $R_m$, lines at different $Y$ values are displaced parallel to the Poiseuille line ($f = 16/R$, $Y = 0$) and have a constant slope of minus one.

Hedstrom[3] also demonstrated the application of dimensional analysis to the flow of Bingham plastics; and Perkins and Glick[4] later showed that the Buckingham equation could be expressed as

$$\frac{1}{R_m} = \frac{f}{16} - \frac{H}{6R_m^2} + \frac{H^4}{3f^3 R_m^8} \tag{11}$$

where

$$H = \frac{\tau_y D^2 g_c}{\eta^2} = R_m Y \tag{12}$$

Hedstrom[3] gives a plot of $f$ versus $R_m$ with both $Y$ and $H$ as parameters. This plot is to a small scale and contains parameter values only for multiples of one, five and ten. A plot to a larger scale with intermediate parameter values is required for convenient and accurate use.

Eqs. (9), (10) and (11) are mathematically equivalent but the yield-number forms Eqs. (9) and (10) involve lower powers and smaller numbers and are, therefore, somewhat easier to work with. Moreover the fact that the friction factor-Reynolds number lines on a logarithmic plot at all yield numbers have a constant slope of minus one and are displaced parallel to the Poiseuille line suggests that the yield-number forms are mathematically simpler.

For accurate solutions of $f$, Eq. (10) was programmed for a digital computer for values of $R_m$ from 1 to 100,000 and for values of $Y$ from 1 to 10,000. This range is equivalent to values of $fR_m$ from 16 to 20,407. The results of the solution are presented in Table I and in Figs. 1 and 2. Values of the friction factor, at any value of the yield number, may be obtained from Fig. 1 or Table I by dividing the $fR_m$ product by the $R_m$ value.

The original of Fig. 1 was prepared with maximum care on a sheet 17 × 22-in. of 4 × 5-cycle logarithmic paper. However, the form of the figure reproduced here should suffice for normal calculations. Fig. 1 permits the evaluation of $fR_m$ for any value of $Y$ and, therefore, the value of $f$ for any values of $R_m$ and $Y$.

Fig. 2 is a plot of $f$ vs. $R_m$ for various values of $Y$ and is developed from Fig. 1. Fig. 2 is equivalent to Hedstrom's Fig. 6 but is to a larger and more useful scale and may be considered a precise graphical equivalent of the Buckingham equation. (Fig. 2 is on p. 140.)

The constant yield-number lines have been arbitrarily continued only to an $f$ value of 0.008 or to their intersection with the Karman-Nikuradse line for turbulent flow of Newtonian fluids. Present evidence is to the effect that the transition from laminar to turbulent flow occurs at about $f$ equal to 0.008.

The assistance of Mr. P. Buckley, Mr. J. Hahn and Mr. A. Alcorn with the programming of the calculations and the preparation of the figures is gratefully acknowledged.

## Nomenclature

| | |
|---|---|
| $D$ | Pipe diameter, ft. |
| $f$ | Fanning friction factor, dimensionless. |
| $g_c$ | Constant = 32.174 (lb. mass) (ft.)/(lb. force) (sec.$^2$). |
| $H$ | Hedstrom number = $R_m Y$, dimensionless. |
| $L$ | Pipe length, ft. |
| $\Delta P$ | Pressure drop, lb./sq. ft. |
| $R_m$ | Modified Reynolds number $DV\rho/\eta$, dimensionless. |
| $V$ | Velocity, fps. |
| $Y$ | Dimensionless constant $D\tau_y g_c/V\eta$. |
| $\eta$ | Coefficient of rigidity, lb./(sec.) (ft.). |
| $\mu$ | Viscosity, lb./(sec.) (ft.). |
| $\rho$ | Density lb./cu. ft. |
| $\tau_w$ | Unit shearing stress at pipe wall, lb./sq. ft. |
| $\tau_y$ | Yield value, lb./sq. ft. |

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3. Hedstrom, B. O. A., *Ind. Eng. Chem.*, **44**, 651 (1952).
4. Perkins, A. and J. J. Glick, B. Ch. E. Thesis, University of Delaware (1954).

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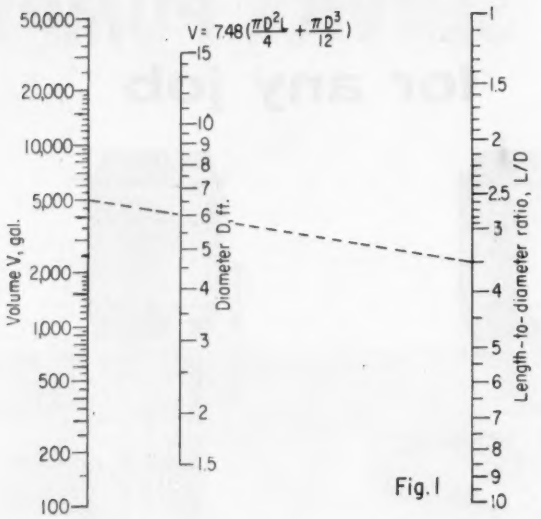


Fig. 1

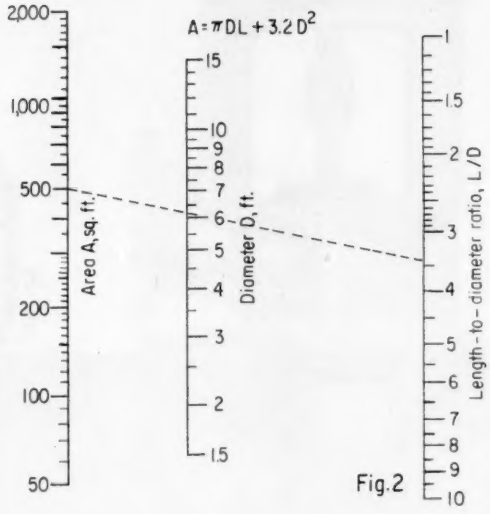


Fig. 2

# New Charts Aid in Vessel Design

**Vessel designers can save time in finding length, diameter and surface for a given tank capacity with these two nomographs.**

**William Resnick, Chicago, Ill.**

Frequently, the process engineer is required to size cylindrical vessels and drums. After sizing the vessel or drum, the engineer must often estimate the surface area of the vessel he has just designed. Here are two new charts for vessels with 2:1 ellipsoidal heads which will reduce the effort required to solve these problems.

Where a particular length-to-diameter ratio is desired, the nomograph in Fig. 1 will permit sizing the vessel without recourse to a trial-and-error solution.

As an example, find the dimensions of a vessel having a capacity of 5,000 gal. and a length-to-diameter ratio which is between 3 and 4.

A straight line drawn between 5,000 on the volume scale and 6 on the diameter scale intercepts 3.5 on the $L/D$ scale. So, $L/D$ equals 3.5, which satisfies the design requirements. The dimensions of the vessel would therefore be 6 × 21 ft.

The surface area of the vessel must be known for estimating insulation requirements, and also for estimating vessel weight and cost. The nomograph of Fig. 2 can be used to determine the surface area of a vessel sized with the aid of Fig. 1. The diameter used in Fig. 2 should, of course, be the outside diameter, whereas the inside diameter is used with Fig. 1.

Assume the vessel sized above is to be of steel 1 in. thick. What will be the approximate weight of the vessel? The outside diameter of the vessel will be 6.17 ft. and the $L/D$ ratio will now be 21/6.17 or 3.40. Using Fig. 2, draw a straight line from $L/D$ = 3.40 through $D$ = 6.17 to the $A$ scale. The intercept representing the surface area is 500 sq.ft.

The density of steel is 490 lb./cu.ft. Therefore, the weight of a sq.ft.-in. is 490/12 or 40.8 lb. Since the volume of steel in this vessel is 500 sq.ft.-in., the approximate weight of the vessel will be 500 × 40.8 or 20,400 lb.

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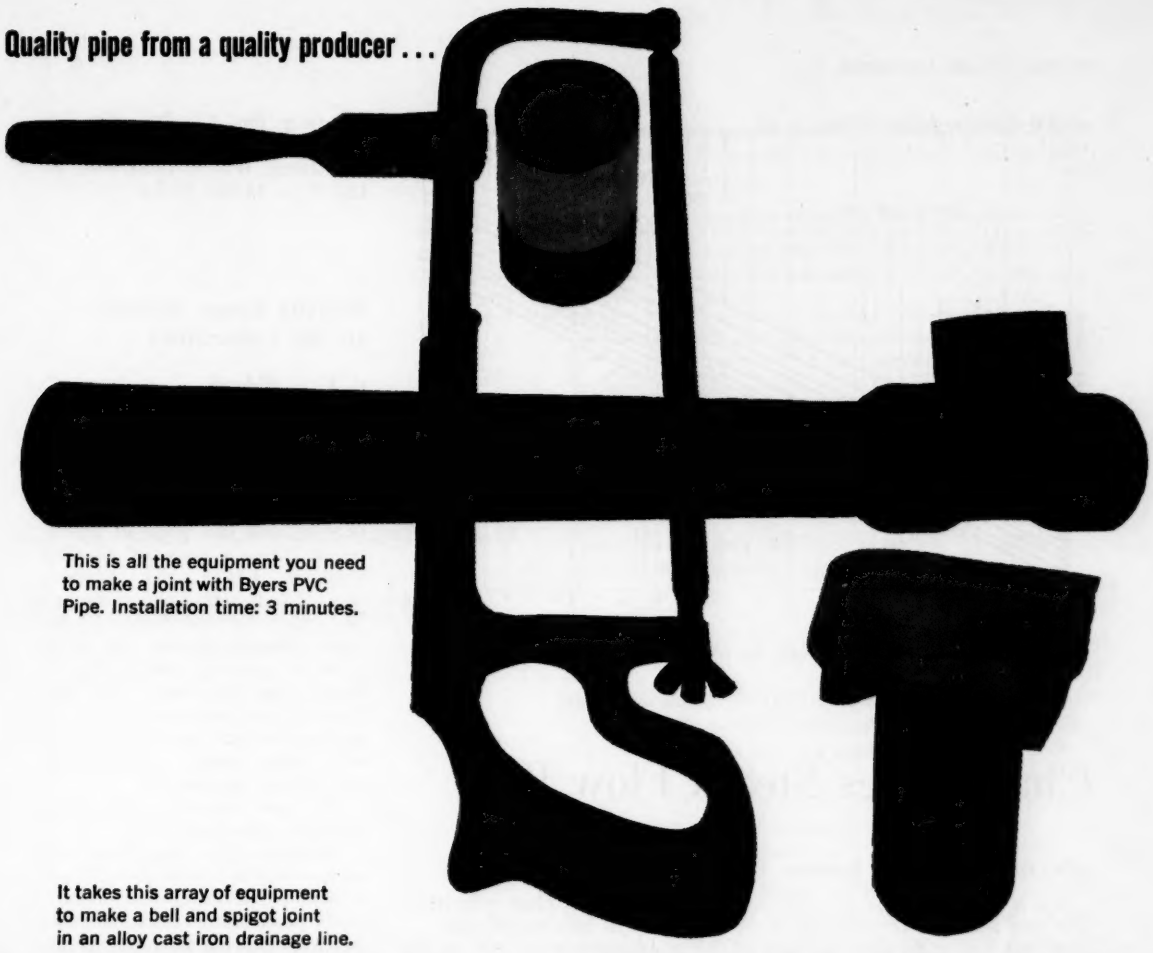

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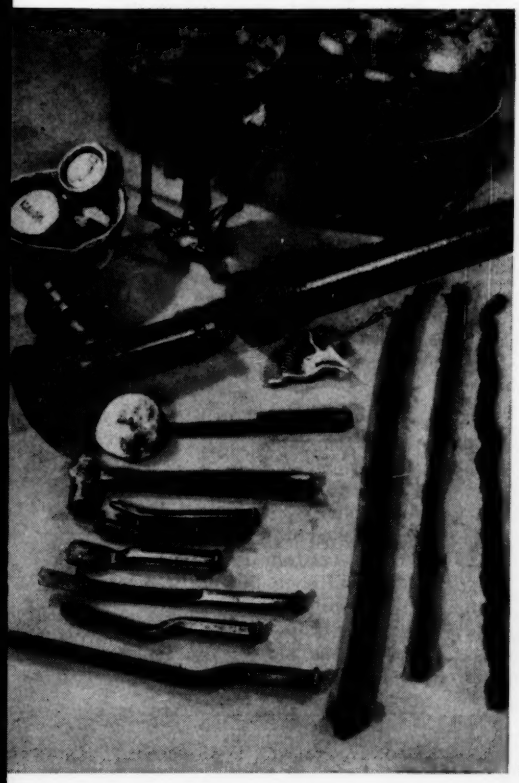

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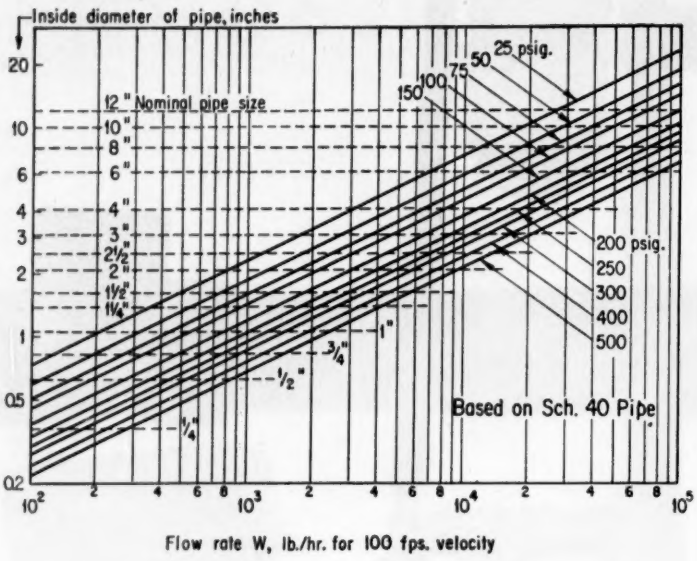



# Chart Gives Steam Flow Rate

**P. V. Folchi, Consulting Engineer, Cincinnati 13, Ohio.**

It's a simple matter to calculate the steam flow through a pipe, but, for many such calculations, the chart above will be of considerable assistance.

The family of lines shown, representing steam pressures from 25 to 500 psig., is drawn for steam velocities of 100 fps. Thus, at 100 fps., a 6-in. pipe will carry about 7,000 lb./hr. of 25-psig. steam. At other velocities, delivery will be proportional.

For example, what will be the velocity of 20,000 lb./hr. of 150-psig. steam in 6-in. pipe? At 100 fps., 6-in. pipe will flow 26,500 lb./hr. of 150-psig. steam. So, velocity will be (20,000/26,500) $\times$ 100 = 75.5 fps.

Again, find the flow rate in 3-in. Sch. 40 pipe for steam at 300 psig. and 150 fps. On the chart $W$ at 100 fps. = 12,300 lb./hr. Hence, $W_{150}$ = (150/100) $\times$ 12,300 = 18,500 lb./hr.

## NEXT ISSUE: Watch for Midsummer Contest Winner

### ★ How Readers Can Win

**$50 Prize for a Good Idea**—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

**$100 Annual Prize**—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

**How to Enter Contest**—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

## Making Large Samples In the Laboratory

**C. F. A. Roberts**
*Supt., Plant Investigations Dept.*
*Orr's Zinc White Ltd.*
*Widnes, Lancs., England.*

After the research department has worked out a new product or process and you want to test it on as large a scale as possible (pounds rather than grams), you often find that the necessary pilot plant is unavailable. Under these circumstances, the work must be done in the laboratory itself. The laboratory staff will have to work on as large a scale as possible but—such is the force of habit—using conventional laboratory apparatus.

For such occasions these suggestions may be helpful:

*Heating*—It's dangerous, inconvenient and inefficient to heat a large evaporating dish precariously poised on a tripod over two or three bunsen burners. If using a bucket won't harm your product, try it instead of the dish. In any event, get rid of the tripod and bunsen burners in favor of an ordinary domestic ring burner. The equipment will be lower, more accessible and will heat more evenly than usual laboratory equipment.

*Filtration*—An outsize Büchner filter balanced on the lab bench is awkward to get at, a potential hazard and messy to use since it will need frequent dismantling. Where you have a large volume of liquid to filter, try this trouble saving trick:

Put the filter and filter flask on the floor, if necessary with some suitable support under the funnel. Connect the flask outlet by rubber tube to one of two inlets to a carboy on the bench. The second carboy inlet is connected to the vacuum line. The filter flask will soon fill but then the liquid will simply run into the carboy which, when filled, is replaced and becomes a convenient source of filtered liquid ready for siphoning.

# How to cut costs and get longer service from rubber products

**Specify rubber goods made of Du Pont neoprene or HYPALON®!** They outlast products made with ordinary rubber. For example:

HYPALON lined pump casings show no evidence of corrosive attack after one year service in caustic soda-chlorine manufacturing unit. Natural rubber failed within two months.

Neoprene pipe linings in cooling water return line in a refinery have served for over two years. Other linings failed within a year when exposed to water containing 18,000 ppm. salt and traces of oil.

HYPALON hose has carried hypochlorite since May, 1954. Other hose broke down in a few months.

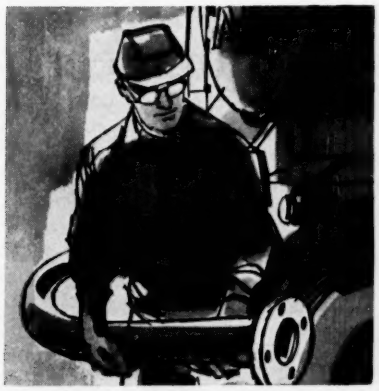
Neoprene sleeve valves have been exposed to 265° F. steam and submerged in soda ash storage tanks since 1955. Maintenance costs have been reduced.

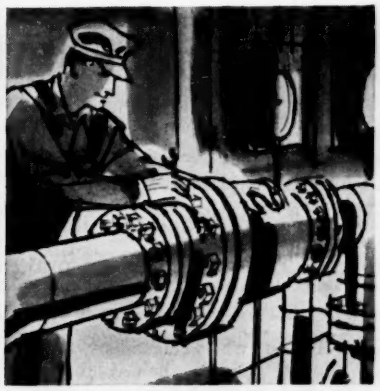
Maintenance products of neoprene and HYPALON offer economy . . . longer service per dollar, reduced replacement costs, minimum downtime.

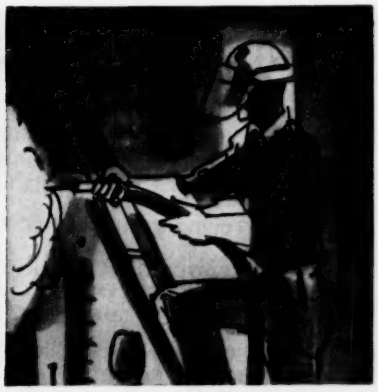
**Neoprene and HYPALON assure lasting durability** and excellent resistance to a wide range of deteriorating factors. Neoprene is a versatile synthetic rubber, with good resistance to oils and greases, most organic and inorganic chemicals. HYPALON is a special-purpose synthetic rubber which is heat-resistant, ozone-proof and impervious to most oxidizing chemicals.

**Your local rubber goods distributor** carries maintenance products of neoprene and HYPALON. He can recommend the right product to meet your needs. Call him soon. For more information write for "Du Pont Elastomers in Industry," E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. CE-8, Wilmington 98, Del.

Rubber products of neoprene and HYPALON last longer







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REG. U. S. PAT. OFF.

Better Things for Better Living . . . *through Chemistry*

SYNTHETIC RUBBER

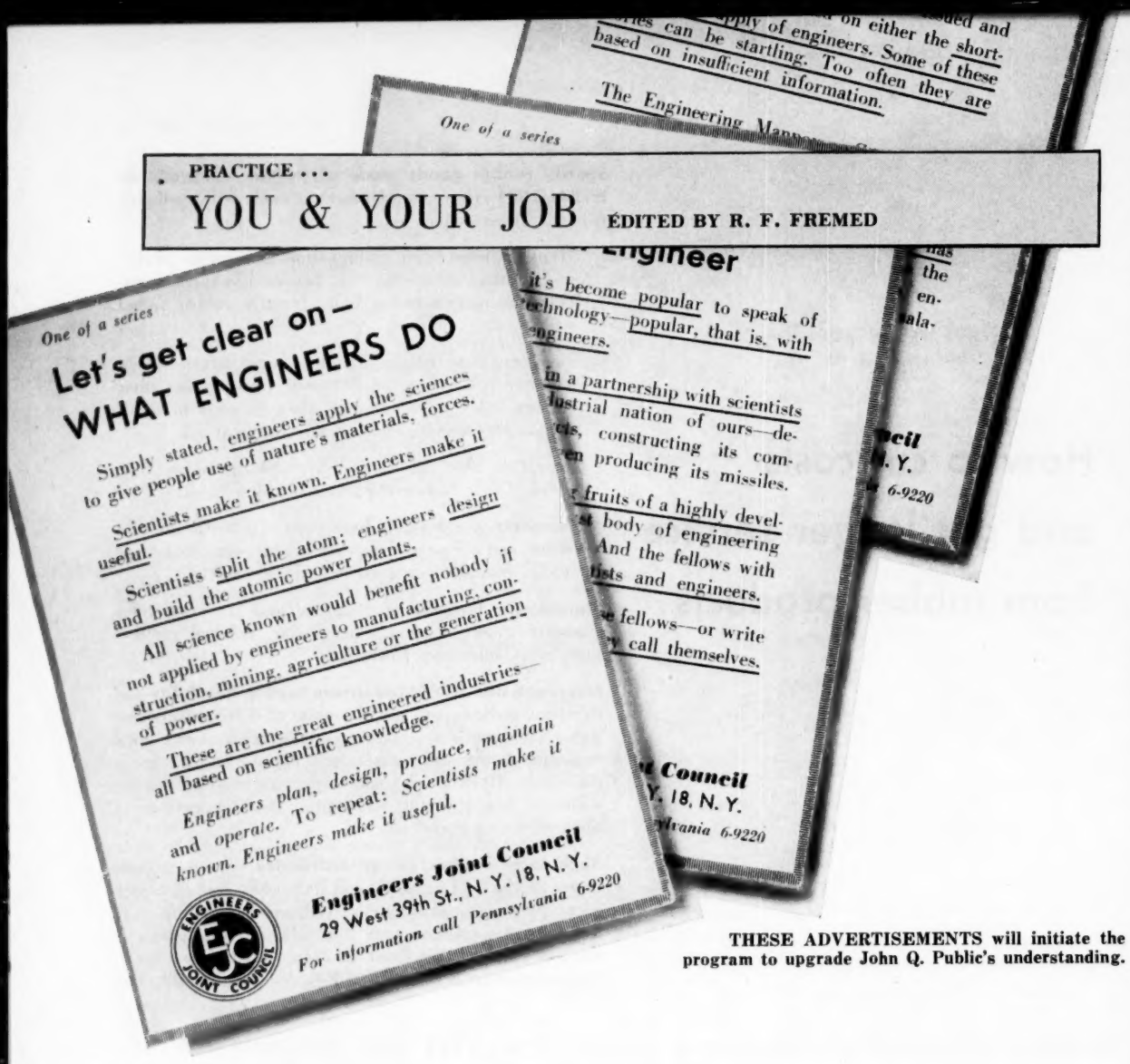
NEOPRENE
HYPALON®
VITON® *n*
ADIPRENE®

**Trademark for Du Pont Synthetic Rubber*

PRACTICE . . .

# YOU & YOUR JOB

EDITED BY R. F. FREMED


One of a series
Let's get clear on—
WHAT ENGINEERS DO
Simply stated, engineers apply the sciences to give people use of nature's materials, forces.
Scientists make it known. Engineers make it useful.
Scientists split the atom; engineers design and build the atomic power plants.
All science known would benefit nobody if not applied by engineers to manufacturing, construction, mining, agriculture or the generation of power.
These are the great engineered industries all based on scientific knowledge.
Engineers plan, design, produce, maintain and operate. To repeat: Scientists make it known. Engineers make it useful.
Engineers Joint Council
29 West 39th St., N. Y. 18, N. Y.
For information call Pennsylvania 6-9220
ENGINEERS EJC JOINT COUNCIL
One of a series
Engineer
it's become popular to speak of
echnology—popular, that is, with
ngineers.
in a partnership with scientists
dustrial nation of ours—de-
cts, constructing its com-
en producing its missiles.
fruits of a highly devel-
body of engineering
And the fellows with
ists and engineers.
fellows—or write
call themselves.
Council
Y. 18, N. Y.
lvania 6-9220
6-9220

**THESE ADVERTISEMENTS will initiate the program to upgrade John Q. Public's understanding.**

# Say *Engineer* When You Mean Engineer

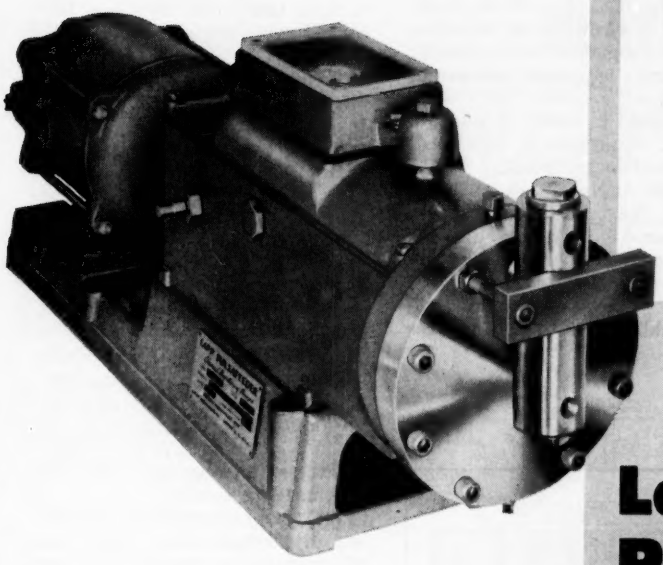
**Engineers Joint Council kicks off its campaign to recast your image. Goal is to convince the public that "Scientists make it known, but engineers make it work!"**

As members of the engineering profession, we are all concerned with the problem of who speaks for us and what the speaker has to say about us. Of some concern, also, is the image that forms on the retina of the public eye when the words engineer and engineering are used.

That's why Engineers Joint Council (EJC) has just embarked on an advertising campaign designed to give the public —through the public press—a more desirable picture of what engineers are and what engineering is. A series of six quarter-page ads (some are shown above) has been scheduled for insertion in *Editor & Publisher*, a business magazine that reaches some 21,000 editors, radio and TV script writers, film continuity writers, newspaper reporters, rewrite men and other members of the fourth estate.

Theme of the series will be:

# These fluids are difficult to meter...



FORMALDEHYDE
MERCURY
MOLTEN METALS
SULFUR DIOXIDE
HYDROBROMIC ACID
SULFURIC ACID
HYDROCHLORIC ACID
LIQUID BROMINE
LIQUID CHLORINE
FLUORINE GAS
HYDROFLUORIC ACID
HYDROGEN FLUORIDE
SULFUR DICHLORIDE

## They are handled successfully by the

# Lapp PULSAFEEDER

## CONTROLLED-VOLUME CHEMICAL PUMP

The Lapp Pulsafeeder is a highly-specialized, precision pump suited to a wide variety of special applications involving controlled-volume pumping of fluids. It's a combination piston-diaphragm pump having a hydraulically balanced diaphragm and a closed hydraulic system. The reciprocating piston action provides accuracy of positive displacement while the diaphragm isolates liquid being pumped from the pump's working parts. Eliminates need for stuffing box or running seal . . . prevents product leakage and contamination. Pumping speed is constant, variable flow results from variation in piston-stroke length . . . controlled manually by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable. Pulsafeeder capacities range from 585 ML per hour up to 24 gpm maximum flow and pressures from minus atmospheric to 6800 psig.

Specify Lapp Pulsafeeder when you need continuous (or intermittent) pumping, at accurately controlled volume, of fluids which cannot be satisfactorily exposed to conventional pistons, cylinders and stuffing box packing. Or because of the corrosive action of chemicals and/or the need for protection of product against contamination.

**Lapp**

**WRITE FOR BULLETIN 440** containing typical applications, flow charts, description and specifications of models of various capacities and constructions. Lapp Insulator Co., Inc., Process Equipment Division, 3610 Poplar Street, Le Roy, New York.

"Scientists make it known, but engineers make it work!" In capsule form, here's what the six ads will say:

• Say engineer when you mean engineer. When you speak of engineers or write about them, call them what they call themselves. Call them engineers.

• Let's get clear on what engineers do. Engineers plan, design, produce, maintain and operate.

• Engineer shortage? Who says? The Engineering Manpower Commission always has the up-to-date facts.

• Just who's firing those missiles? Engineers don't want to take credit from the scientists, upon whose original research the missile program is based, but they do feel that the public should recognize engineering as a major force in the missile program.

• Creep? Fatigue? Every occupation has its jargon. Engineering jargon is as readily translated as that used by newspapermen. When you need help on a story, consult Engineers Joint Council.

• Who, what, when, where and why still belong somewhere in the news story. And *who* still leads the list. Too often, engineering news events are reported as if they somehow, miraculously, got done, happened, occurred, evolved.

A bridge is built. A mine is opened. A process is developed. A product is perfected.

People, engineers, do all these things; they don't just happen. Engineers *with names* are the creative minds behind every engineered product and project you report. Use their names and make all those passive verbs active.

## Enoch Needles Speaks for 350,000 Engineers

**Invited to testify before the Senate Committee on Government Operations, Enoch R. Needles (seated center in photo), president of Engineers Joint Council, had this to say about the creation of a cabinet-level Department of Science and Technology.**

**"We strongly urge that any administrative development in this field be properly identified as 'science and engineering,' since science provides us with the basic knowledge of our environment and engineering furnishes the means by which this knowledge is made useful."**

**Who Speaks for You?**

In each of these ads, Engineers Joint Council offers itself as a source of information and reference on the broad aspects of the engineer's responsibility, his education and his work.

Of course many individuals and small special-interest groups have been criticized for taking it upon themselves to speak for all engineers and all of engineering. (On the other hand, there have been charges made that no one is speaking for the engineer; that something is muffling the voice of the engineer.)

But EJC is not a small special-interest group. If we can agree that there are about 750,000 people in the United States who earn their livelihood by supplying what employers choose to call engineering services, then EJC can claim to represent a little less than half of these people. Membership in the constituent societies of EJC amounts to almost 350,000. However, we must remember that some engineers pay dues to more than one engineering society.

For comparison, let's consider another organization that has been doing an energetic and effective job of speaking for the engineering profession. In a recent news release, the National Society of Professional Engineers (NSPE) announces that its membership has now reached the 50,000 mark. In reply to *CE's* query, NSPE headquarters in Washington, D. C. estimated that two-thirds of these 50,000 members also belong to another engineering society.

**Who Else Speaks for You?**

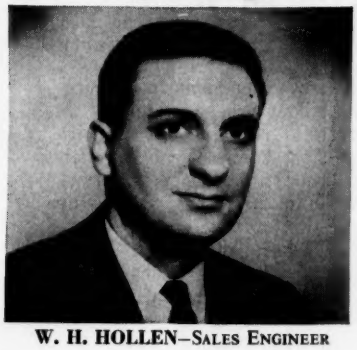
In addition to the programs of EJC and NSPE there are a number of scattered public relations activities that are supported in large part by assorted engineering societies.

Of the five founder societies, ASME and ASCE each have a full-time, but small, public relations operation. AIEE and AIChE have no full-time public relations operations, although they do employ public relations counsel. The miners also buy public relations counsel on a somewhat limited basis.

Together, the constituent engineering societies support the

News from
National Carbon Company
Division of Union Carbide Corporation • 30 East 42nd Street, New York 17, N. Y.
*Sales Offices:* Atlanta, Chicago, Dallas, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. IN CANADA: Union Carbide Canada Limited, Toronto

## National Carbon representatives expand your engineering force



W. H. HOLLEN—SALES ENGINEER

Mr. Hollen has been with National Carbon Company since 1955 when he graduated from Fenn College with a B.S. Degree in Chemical Engineering.

He has worked on the development and design of chemical process equipment, and worked directly with users on the installation of carbon, graphite and "Karbate" impervious graphite equipment. Recently, he has been named field sales engineer covering the mid-continent states. His headquarters are in St. Louis.

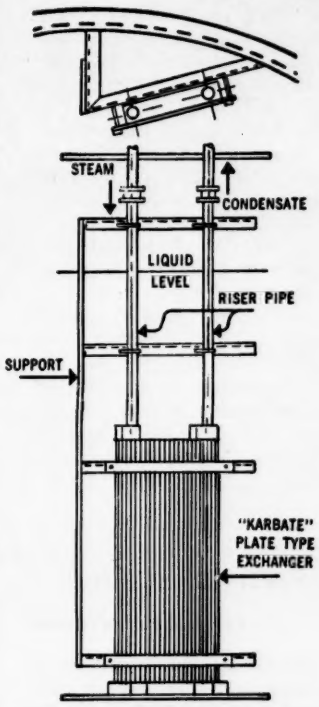
## NEW CATALOG AVAILABLE ON IMMERSION TYPE HEAT EXCHANGERS

A new 12-page catalog on immersion type heat exchangers and circulating steam jets is available from National Carbon Company. It contains complete information on application, installation and operation of standard plate, bayonet, and coil type exchangers, plus circulation steam jets. Write for CATALOG NUMBER S-6620.

NATIONAL
TRADE MARK

"National", "Karbate", "N" and Shield Device and "Union Carbide" are registered trade-marks of Union Carbide Corporation.
UNION CARBIDE

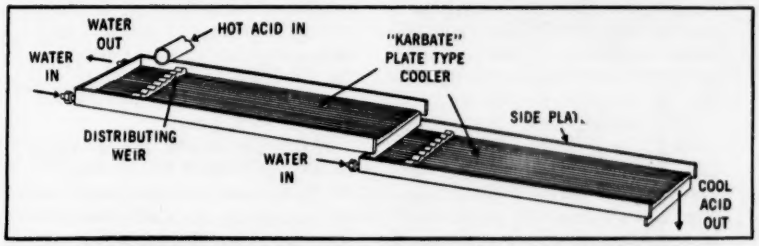
# UNIQUE INSTALLATIONS SHOW ADAPTABILITY OF "KARBATE" PLATE EXCHANGERS




## "KARBATE" PLATE HEATERS USED IN STARCH MODIFYING PROCESS

In 1956, nine 94" long "Karbate" impervious graphite plate heaters, style VVFS-2, were installed in a starch modifying tank. The complete corrosion resistance and rugged construction of this type of exchanger were factors for its selection in this application. Steam is used as the heating medium.

On the basis of this installation, four additional starch modifying tanks were equipped with "Karbate" plate type units in 1957.




## "KARBATE" PLATE EXCHANGERS USED AS TROUGH COOLER

"Karbate" plate exchangers, style VVUS-2, are used to cool 85 to 106% phosphoric acid produced by the thermal process. The standard plate type exchanger is fitted with "Karbate" impervious graphite side, end and drip plates to form a trough. Troughs are installed at a slight incline permitting the acid to flow down the fins. The number of plates in series and/or parallel depends on the cooling required. Some installations are handling acids having inlet temperatures of 400° to 450°F.

general engineering public relations program that is directed by EJC. But support is a questionable word to be used in this context. Money talks; and it takes money to talk to the public.

**Who Spends What?**

How much money is being spent to speak for the engineering profession?

Well, the series of ads in the EJC campaign are being run on the promise that about $1,500 will be donated by the engineering societies who are most interested in the campaign. The total operating budget of Engineers Joint Council for 1959 will amount to a little under $100,000.

Of this, less than $6,000 is allocated for the entire public relations function. That comes to about 2¢ per represented engineer per year.

Once again let's look at NSPE for a comparison. The 50,000 members pay average annual dues of $25. Of this, $10 goes to national headquarters, $10 goes to the state societies and $5 stays behind for work on the local level. In 1959 the national headquarters budget of NSPE will add up to about $553,000. For National Engineers' Week, alone, NSPE will spend $20,000 to $25,000; and the state societies will spend an aggregate of five times that amount locally.

**How Much Should Be Spent?**

We know that what follows might be attacked as an unfair comparison, but to view engineering public relations expenditures in proper perspective let's examine some comparable figures for the medical profession.

The American Medical Assn. (AMA) is a loose affiliation of local medical societies. As is the case in the engineering profession, not all members of the medical profession are members of their professional societies. Of the 239,500 licensed physicians in the U. S. today (according to AMA's latest count), only 176,437 are members of AMA. That's about 74%.

Leo E. Brown, public relations director of AMA, estimates that his budget for 1958 ran to about $1,195,000, covering the activities of a full-time public relations staff of 60 people. By simple division, the AMA is spending over $6.50 per affiliated doctor per year for public relations on a national level. Add to that the efforts of the local medical societies.

**Unmuffling the Voice**

In an effort to focus attention on the public relations problems of the engineering profession, EJC sponsored a forum last winter at the Engineers' Club in New York. A panel of eight speakers interchanged ideas with an audience of 76 engineers, technical editors and public relations people. (An edited transcript of the proceedings is available from Engineers Joint Council, 29 West 39th St., New York 18, N. Y., at 50¢/copy.)

The question of the day was: "What's Muffling the Voice of the Engineer?"

There's one rather obvious answer to the question. The thing that can unmuffle the voice of the engineer is a secret ingredient called money. Money talks; and it takes money to speak for the engineering profession.

---

## MASTER OF SCIENCE

### . . . *Is Optimum Level*

Addressing the members of the chemical engineering division of American Society for Engineering Education, C. C. Monrad of Carnegie Tech has predicted that by 1963 the needs of the teaching profession alone will require 250 Ph. D. chemical engineers each year.

However, except for a slight bulge right after World War II, we have been producing only 140 or so a year. In fact, last year the number dropped to 127 (*Chem. Eng.*, March 23, 1959, p. 87).

Monrad suggests that as long as there is no economic advantage to the Ph. D. degree, there will be difficulty in satisfying the demands of industry and education for holders of the degree. "Contrary to the situation in science, where a Ph. D. degree is almost a prerequisite for an exciting career, the M. S. degree has been the optimum for the more gifted chemical engineer from the standpoint of opening various doors to success.

"Relatively few positions have actually required Ph. D. training."

## GET A PH. D.

### . . . *Cooperatively*

A new experiment in cooperative education—combining an industrial research career with graduate studies—will be initiated this fall by the University of Cincinnati. This will be an expansion of Cincinnati's 53-yr.-old, work-and-study plan of education.

Until now cooperative education has only been available on the undergraduate level. It's believed that this will be the first program to reach up onto the graduate level. Students will work toward master's and doctor's degrees while being paid to do basic research under fellowships sponsored by industry.

Doctorates in physics and chemical and metallurgical engineering will be offered first. University officials expect that the program "will open the way to advanced degrees for hundreds of qualified engineers now employed in the research laboratories of industry."

## WIVES TO SEE

### . . . *for Themselves*

A program of planned tours for wives of employees has been started by Aerojet-General Corp. at its solid- and liquid-rocket plants in Sacramento, Calif.

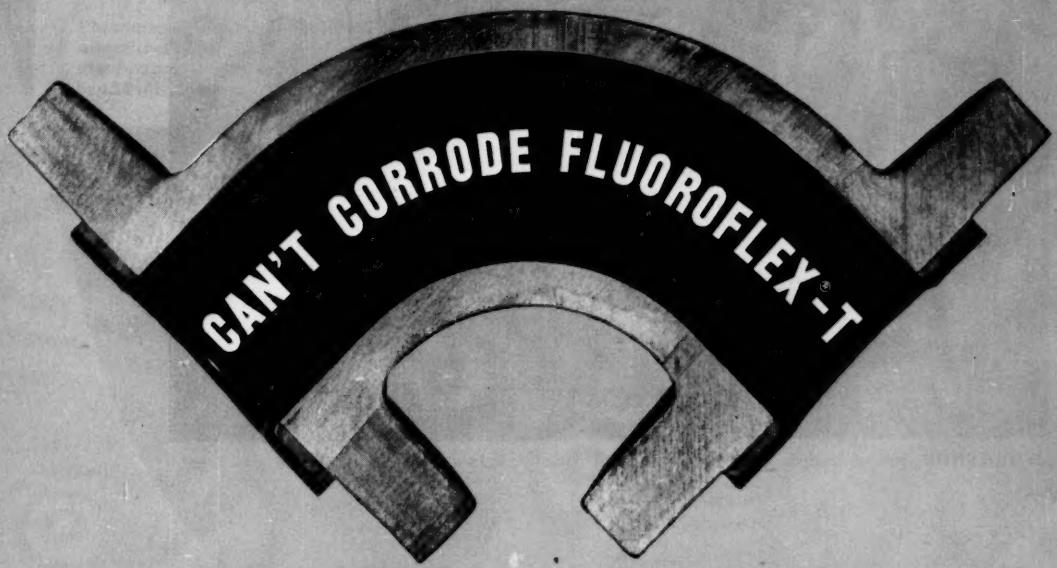
Tours will be held Monday through Thursday evenings from 6 until 9:30 P.M. while Daddy stays home to baby sit. Security regulations will limit the itinerary to unclassified areas of the plants.

The company is sponsoring the program because it feels that wives should be able to see the vital nature of the work that their husbands are spending long hours on.

any acid

...in any concentration

...at any temperature to 500°F

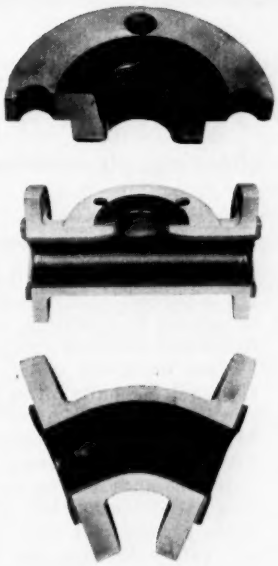



TEFLON® AT ITS BEST BY A PATENTED PROCESS

Fluoroflex-TS fittings are lined with specially processed* Teflon to provide maximum density and minimum crystallinity. These characteristics are essential to assure a nonporous lining free from fatigue cracks. Type TS fittings are maintenance-free even in the most corrosive service.

Liners are seamless with smooth contours for maximum flow and minimum back pressure. Housings are one piece ductile iron with 150# ratings to ASA dimensional standards (modified side outlet "Tee"). Ells are short radius for compact systems; reducing flanges are tapered. Change of direction or flow is never abrupt. Fluoroflex-TS fittings will mate with any 150# flange connections in existing piping systems.

Proven in continuous service, Fluoroflex-TS pipe handles the toughest problems of corrosion, erosion and contamination—with complete safety. Write Dept. 290 for Bulletin TS-1A, RESISTOFLEX CORPORATION, Roseland, N. J.



*Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
*Teflon is DuPont's trademark for TFE fluorocarbon resins.

* Pat. No. 2,752,637

*Complete systems for corrosive service*

**RESISTOFLEX**

PRACTICE . . .

## OPERATION & MAINTENANCE

EDITED BY M. D. ROBBINS

WORKSHOP group-studies before startup provide valuable design data and cut costs.

# Startup and Shutdown Procedures

**This is the first of two articles on the detailed procedures you have to go through when putting a new unit on-the-line. Safety, training, checking, all work well with good advance planning and scheduling.**

C. A. HANSEN, Sr. Supervising Engineer, Technical Div., Humble Oil and Refining Co., Baytown, Tex.

STARTING up or shutting down a process unit presents real challenges to operating, maintenance and technical groups.

Good teamwork using all the skill and ingenuity these groups can muster is a necessity in bringing these operations to their utmost in efficiency.

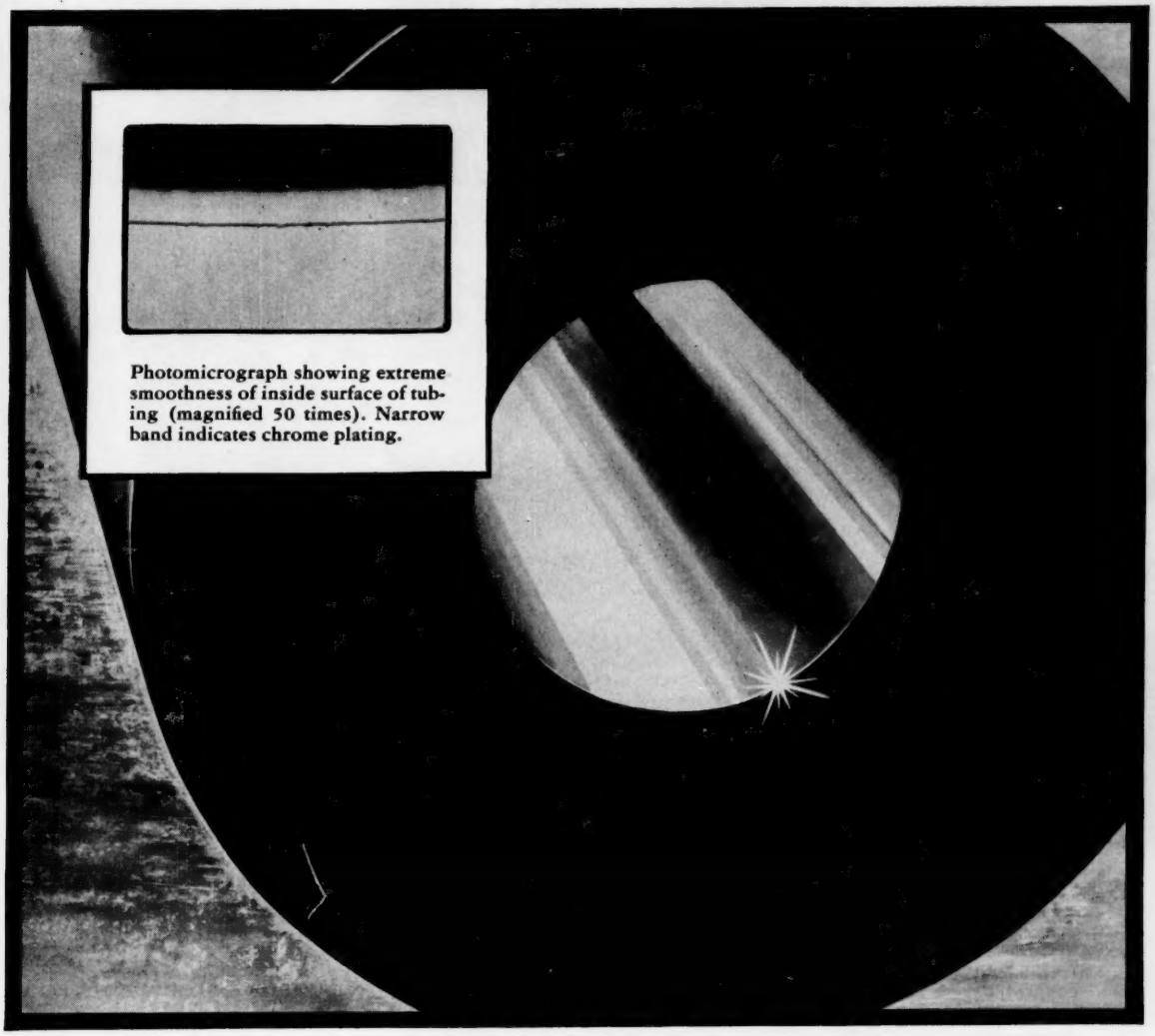
It's because of the continual change of conditions during these periods that more personnel safety hazards are caused and equipment is subjected to more borderline operations than at any other time during a normal run.

With improvements in technology and operating techniques, the frequency of these operations is becoming less and less. Emphasis must be increased to insure that good procedure is followed.

### Test of Skill and Judgement

Startup and shutdown procedures are a timeworn subject; few additions to our knowledge in this field have been made over the years. Except for the initial startup and shutdown of a new unit, this is an area where trial and error on a particular installation, over the years, culminates into the best over-all arrangement with proper control.

This point, in itself, presents one of the biggest challenges to best operation since it's quite easy for procedures to deteriorate instead of improve. Continuous follow-up and communication with all operating forces is required to keep everyone in-



Photomicrograph showing extreme smoothness of inside surface of tubing (magnified 50 times). Narrow band indicates chrome plating.

# How to beat fatigue

## *caused by pulsating pressures up to 50,000 psi*

**PROBLEM:** Manufacturers of polyethylene plastic were plagued by *costly* fatigue failures in the heavy wall, high pressure steel tubing they were using. *Result:* Costly, frequent replacements with attendant production and time losses.

**CAUSE:** The tubing's inside surface had slight, almost invisible imperfections which gave the pulsating pressures—varying between 35,000 and 50,000 psi—a toe hold for failures to start.

**SOLUTION:** Timken Company metallurgists recommended a specific low-alloy steel tubing that could be produced with a glossy-smooth interior surface. They used specially developed Timken Company processing techniques, based on more than 40 years of experience with all types of high pressure steel applications. Result—another special steel problem solved.

**WHATEVER** your special steel problem, it will pay you to use the experience of the experts—metallurgists of the Timken Company. Give us a call the next time you need help. The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

**TIMKEN® *Fine Alloy* STEEL**

**TRAINING PROGRAMS should include adequate classroom work and on-the-job-training. Assign the operating staff well in advance of completion. Make use of detailed directions and enlarged flow charts for instruction and training.**

formed of the experiences encountered.

Difficulties in this area are compounded since it's normal for each startup and shutdown to be somewhat different because of some special, unforeseen problem. Startup or shutdown of a unit is usually a good test of the skill of operating forces.

**Fix the Ground Rules**

Probably the best practice in preparing procedures, and instructing your operators on how to use them, is to provide maximum flexibility and instill basic principles. Recognize that you can't foresee all difficulties and you must prepare operating people for the unusual so they have the basic tools to cope with various situations.

Procedures are only a starting point; they have to be altered to meet varying conditions if you want to achieve your goal of maximum economy and safety. You can't make deviations and shortcuts because they are easier or faster even though they may not be quite as safe or economical as standard procedures.

Establish a set of ground rules for good startup and shutdown practices to permit evaluation of procedures and deviations. The following pointers present the more important facets of such a basis:

*Consider safety at all times during startup and shutdown operations* — These periods are much more hazardous to men and equipment than normal, routine operations. Conditions are in a continuous state of change. Everything must be watched more closely.

All normal operating hazards, such as overpressuring, excessive temperatures, explosive mixtures, loss of pump or compressor suction, leaks, water in the equipment, etc. are much more likely to be encountered and must be reckoned with. Facilities and procedures to handle the various situations should be continually reviewed and revised when necessary.

*Strive for maximum economy but safety comes first if these items are incompatible on a particular point* — Maximum economy is made up of many things such as minimum time, loss of throughput products, treating chemicals or catalysts and the smooth meshing of the process with other operations.

*Minimize pollution*—Strict adherence to the first two principles usually takes care of this item. However, special problems do sometimes occur during startup and shutdown making pollution control a difficult job. Work out facilities and/or procedures to handle when needed.

*Procedures should be detailed* —There are many advantages for such a practice. Most important is that many significant problems have been found and corrected as a result of prepar-

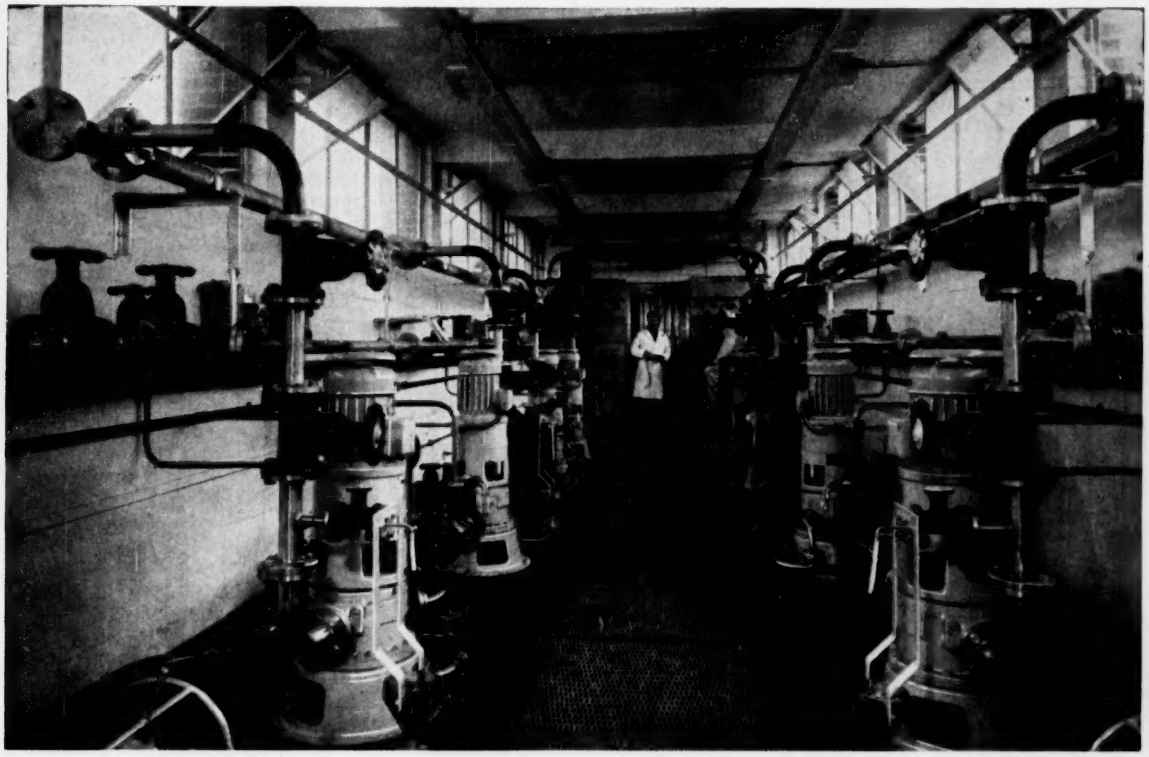


*Photo by courtesy of the United Kingdom Atomic Energy Authority*

# LaBour Pumps Handle Tough Atomic Energy Jobs

The LaBour Type G Packingless Pumps in the picture are part of more than 250 LaBour Pumps in this one establishment of the United Kingdom Atomic Energy Authority. Where the job is difficult, or where failure of a pump can be especially costly or hazardous, you are likely to find LaBour Pumps on the job. British engineers, like those in the rest of the world, know that when you can't afford to take a chance you take a LaBour.

The pumps in the photograph were built by British LaBour Pump Company, Ltd., in London. In every essential respect, including the carefully controlled casting of corrosion resistant alloys and the final performance check before delivery, they are identical with American-built LaBour Pumps.

British or American, LaBour means dependability in pumping service—and the dependable pump is always the economical one, too. We'll be glad to show you what a LaBour Pump can do for *you*. Just ask us.

***ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP***

**LABOUR**

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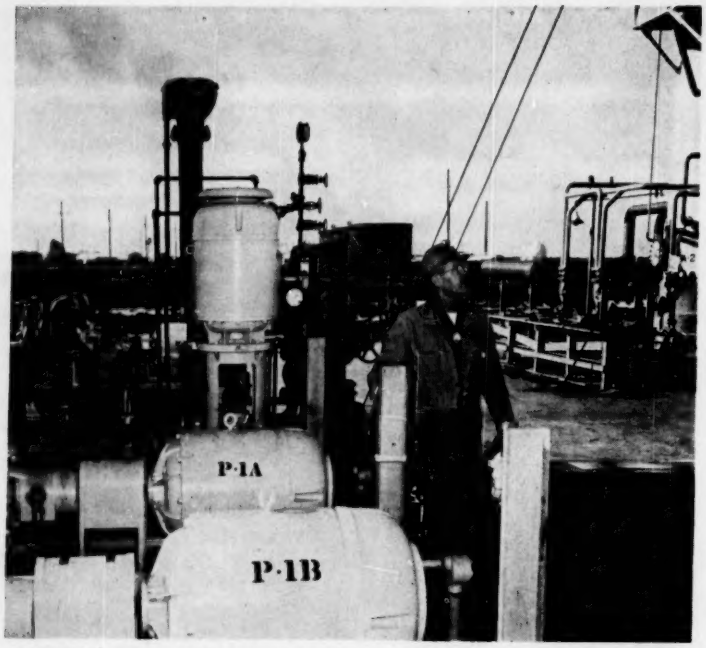


**ASSIGN the operating foreman to the project early in the design stages. Give him responsibility for reviewing safety, operability and maintenance.**

ing or discussing detailed procedures.

Summaries of the detailed procedure are helpful during actual startups and for classroom work. Check-off logs, a compromise between detailed and summary procedures, are a very effective aid to operating forces during actual startups or shutdowns.

Bring your various procedures up to date at least yearly and review them with the operating forces on the same schedule.

*Training the operating personnel is one of the more important parts of effecting good startup and shutdown procedure*—The best equipment and procedures are to no avail if they aren't used properly. The trend toward longer runs intensifies the need for classroom training in this area of operations.

It's now possible for a man to be on a unit several years before he participates in all phases of startup and shutdown operations. On-the-job-training alone is no longer a satisfactory way to handle this problem.

*Prompt followup by the operating foreman is necessary to achieve maximum benefit to all concerned from the new experience*—Reduce this to writing as soon as practicable.

**Then: Detailed Procedures**

Startup of a new unit, particularly if it represents a new process, poses special problems. Proper planning and the careful execution of these plans alleviates many aches and pains normally associated with putting new equipment in service.

Good performance in this field is the result of the same sort of formula found so successful in others. Set up a good, sound over-all procedure and then pay attention to details in carrying the plan to completion.

A good practice on new equipment, is to assign the operating foreman to the project early in the design stages. He should have the responsibility for reviewing safety, operability, flexibility, maintenance, startup and shutdown aspects of the unit and he should have sufficient authority to have revisions or additions made where needed. Many last minute changes or "snitzels" that result in delays to completion are avoided by this practice.

An operating manual covering normal operations, startups, normal and emergency shutdowns should be prepared by the operating man in cooperation with staff and service groups early in the game. Review these instructions with the shift supervisors several months before completion. Don't prepare final drafts of the operating manual until field inspections are made by shift supervisors.

Based on our experience, many changes are made to the manual and usually many minor changes or additions to the unit itself as a result of this preliminary review.

**Training is All-Important**

Assign the entire operating staff to the new unit well in advance of its completion. Normally one month is sufficient time to permit adequate classroom and on-the-job-training but this varies with complexity and size of the new unit and the experience of the operators. Training programs should include:

- Over-all process descriptions with economics.
- Detailed instructions on engineering flowsheets.
- Discussion by experts on unusual equipment, instrumentation, special construction features such as materials or novel arrangements, mechanical and process design bases, emergency equipment and possible sources of trouble due to corrosion, catalyst poisons, fouling, etc.

Detail instructions on normal startups and shutdowns plus the first startup and emergency shutdown. It's extremely helpful, in all such discussions, to have enlarged flowsheets where red, green and yellow pins are used to denote closed, open and on control positions of valves, pumps and compressors. Manipulation of the new unit on paper by the operators is very helpful in bringing out problems and really getting the instructions across.

Permit operators to spend some time on the unit each day

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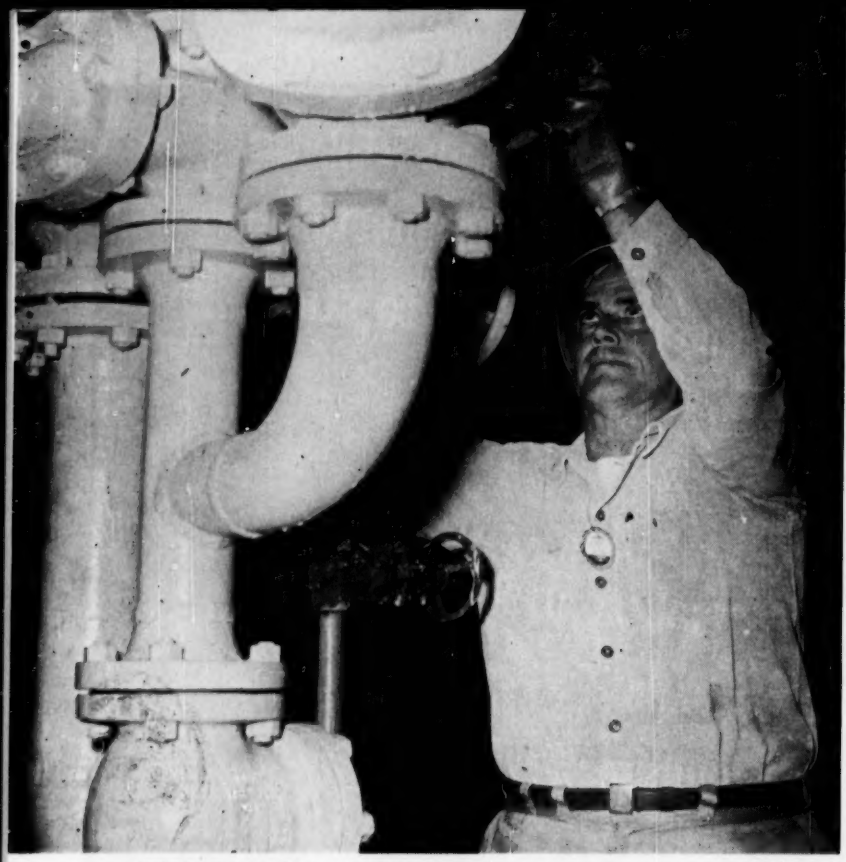


**BEFORE introducing feed to the unit, remove as many uncertainties as possible. Be sure of cleanliness and the good operation of equipment.**

during the formal instruction period so that they can look at the various items discussed in the classroom. Discussion of the unit with construction forces is also helpful.

Encourage actual entry of the operators into vessels and drums. Nothing compares to a three dimension picture of the inside of the equipment in the operators mind. If possible, it's helpful to visit other similar units and to discuss operations with people who have had actual experience with the equipment.

Initial startup poses many uncertainties. It's best to remove as many of these as possible before you introduce the feed to the unit.

Cleanliness, good operation of machinery and good instrument performance can be attained prior to startup. Inspect all vessels, drums and lines for cleanliness and washed out where necessary. Remove control valves and orifice plates.

All pumps should be operated satisfactorily for at least 8 hr. on water or some suitable liquid, preferably with strainers in the pump suction. Make temporary connections, as required, to accomplish this. Compressors should be run satisfactorily for at least 24 hrs. on air.

All instruments should be synchronized, checked for proper operation and setting of alarm points. Check out the emergency facilities.

Strict adherence to these practices introduces much more reliability into the initial startup and enables operating forces to concentrate on maintaining a safe and controllable operation.

One effective method for carrying the above practices to completion is to make a detailed list of all the items that need to be done or checked. A portion of the items are then assigned to each shift supervisor and it becomes his responsibility for getting his items completed satisfactorily.

Close cooperation between construction and operating forces is required to carry out such a program. In many instances, some delay or hindrance to the contractor's work schedule is encountered.

It's highly desirable that the contractor is notified of startup plans early in the game, preferably before a contract is signed, and that his agreement is obtained and recorded through a provision in the contract.

Urge the contractor to get all pump and compressor installations completed well in advance so that repairs and/or revisions to rotating equipment can be completed without delay to the entire unit. Protection of all equipment, especially machinery, from atmospheric corrosion should be required of the contractor.

#### Watch for Complacency

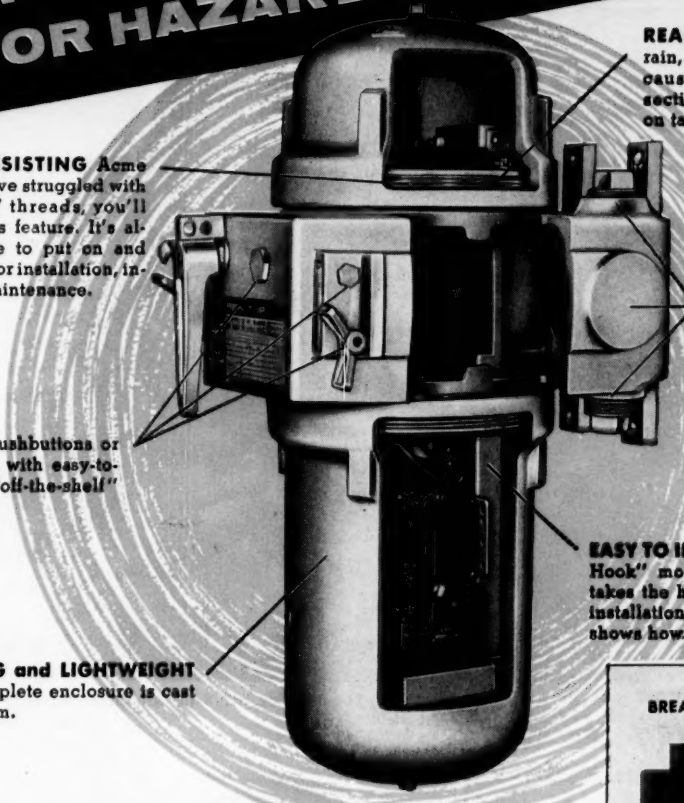
Startup of existing equipment doesn't pose as many new or special problems as does the startup of new equipment. However, there are many pitfalls to avoid, one of the largest is complacency.

Good advance planning and training results in quicker, safer and smoother startups. As noted earlier, keeping procedures and people up to date is one of the largest problems. A firm committment to this goal with continual followup by management is needed.

C. A. HANSEN is a Senior Supervising Engineer in charge of the distillation section in the Technical Div. of Humble's Baytown Refinery. He joined Humble in 1948 after receiving a BS in chemical engineering from Rice. Hansen has extensive experience in thermal cracking, crude distillation and circulating water systems. Since 1953 he has participated in numerous startups.

*Square D announces...*

# NEW SPIN TOP ENCLOSURE FOR HAZARDOUS LOCATIONS



**REAL PROTECTION** against rain, dust, dirt and weather because male threads on collar section engage female threads on tank.

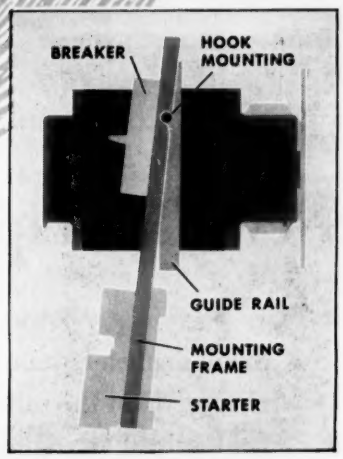
**DAMAGE-RESISTING** Acme thread. If you've struggled with "banged-up" threads, you'll appreciate this feature. It's always a breeze to put on and take off tanks for installation, inspection or maintenance.

**INCREASED WIRING SPACE** and through-feed conduit entrances for horizontal tap-offs.

**EASY TO ADD** pushbuttons or selector switches with easy-to-buy, easy-to-use "off-the-shelf" parts kits.

**EASY TO INSTALL** • "Slide and Hook" mounting arrangement takes the hard work out of the installation job. Diagram below shows how.

**STRONG and LIGHTWEIGHT** The complete enclosure is cast aluminum.




**SLIDE and HOOK MOUNTING**

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The new **SPIN TOP** enclosure is available from your Square D Distributor in three ways—complete device, enclosure only, or components only...for reversing and non-reversing across-the-line starters and combination starters. And for combination and non-combination two-speed starters.

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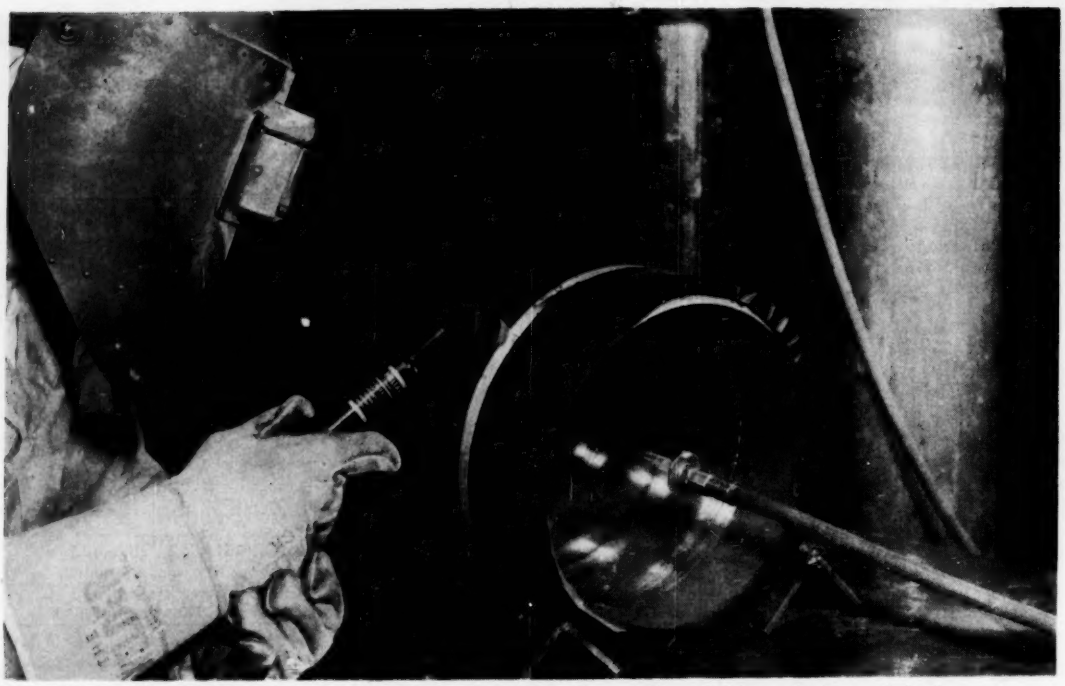


WELDING BREAKTHROUGH permits easy joining, from the outside, of 4-in. and above clad pipe.

# New Clad Pipe: Solid Resistance, Low Cost

**Small-diameter, stainless-clad pipe is now available 10-50% cheaper than the solid-alloy product. Sections are easily field welded (cladding and backing metal) by new "outside" technique.**

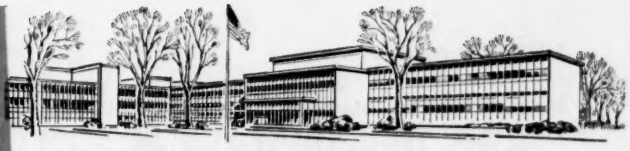
Stainless-clad formed pipe in small diameters—a gleam in the eye only a few years ago—is now commercially feasible, ready to do battle with solid stainless-steel alloys.

In sizes 4-in. and above, the new pipe promises savings of 10 to 50% in material costs over the rolled or extruded solid-alloy product.* Big savings are possible for large diameters and heavy walls. For 4 in., savings show up at schedules of 40 and above.

And Lukens Steel claims there are other savings in supports, expansion loops and joints: solid stainless expands much more

* Costs are not better than centrifugally-cast stainless pipe, but cast pipe is not a big factor in process applications.

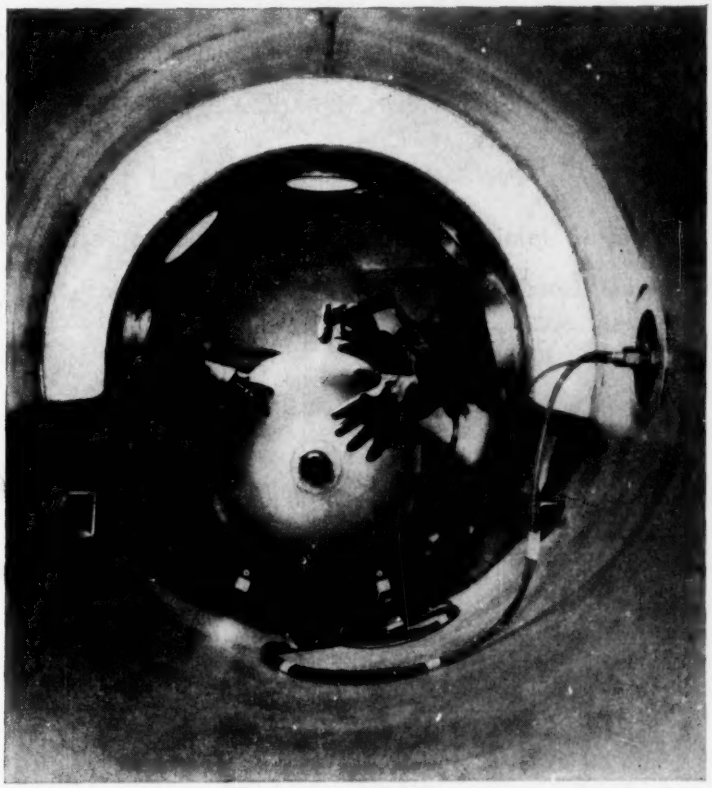
# HAYNES ALLOYS



# RESEARCH REPORTS

Developing new metals and improving current ones to combat the devastating effects of high heat, corrosion, erosion, and abrasion, are the primary objectives of the advanced Research and Development Laboratories at Haynes Stellite Company. HAYNES Tantalum, described below, is one of their more recent achievements. Others will be described in future Research Reports.

Design engineers, metallurgists, and physicists may see in these new metals and alloys opportunities for a breakthrough in applications where limited properties of other metals have presented obstacles. Our research scientists, engineers, and technicians will gladly help you discover whether they can help improve your products.



**HAYNES Tantalum**

Close to 100% pure, chemically. It is produced by the consumable-electrode process. Practically inert to a wide variety of corrosive media, with these added advantages: *Wide* sheets with improved welding characteristics, making it easier to use in chemical and pharmaceutical equipment where corrosion and product contamination must be minimum. Pictured is tantalum reactor liner being welded inside tank of inert gas.

**LARGEST Tantalum Lined Reactor**

An outstanding example of what can be accomplished with the greater sheet width and improved welding characteristics of HAYNES Tantalum is shown above. The vessel—the largest tantalum-lined reactor ever constructed—is a 30-gallon unit designed to operate at 630 deg. F. and 500 psi. Every part that will be exposed to corrosives, including the agitator, is made, or sheathed with, HAYNES Tantalum. For full details on this new material, write for descriptive booklet.

**HAYNES ALLOYS**

**HAYNES STELLITE COMPANY**

*Division of Union Carbide Corporation*

Kokomo, Indiana

UNION CARBIDE

**Address inquiries to Haynes Stellite Company, 420 Lexington Ave., New York 17, N. Y.**

"Haynes," "Haynes Stellite," and "Union Carbide" are registered trade-marks of Union Carbide Corporation

than carbon-steel stainless-clad pipe at high temperatures.

One key factor behind this new development: a unique welding procedure, based on low-carbon-steel transition welds between the stainless clad and the steel backing metal, permits easy joining of pipe sections.

▶**Large Pipe Not New**—Stainless-lined pipe is not new. In large diameters—24-in. and above—it's been available for 20 yr. But welding difficulties have held back the small diameters, until now.

Actually, Lukens has decided on 4 in. as the minimum diameter; above this stainless linings can show some definite savings on a cost/ft. basis.

Cladding thickness will be in the ⅛ to ¼-in. range, or about 10-20%, depending on gage (over-all thickness) and severity of corrosion service.

Cladding below 4-in. will not be available. In that range, the new pipe can't compete very easily with solid stainless. Any material cost advantages are overshadowed by higher manufacturing costs (clad pipe is made batchwise, small diameter solid-stainless pipe in continuous runs).

Lukens has lined up an imposing list of well-known fabricators who can manufacture the new item. It will not be an off-the-shelf material, but made up on a custom basis. This has some disadvantages, since delivery times will be longer than for a stock pipe.

▶**In the Code**—But one design problem has been solved. The ASA has just included clad pipe in their pressure piping code. However, there's a very important restriction: cladding thickness may not be included in determining minimum pipe thickness for a particular pressure; it can only be included in the corrosion allowance.

The ASME Unfired Pressure Vessel Code (Section 8) allows you to include the cladding material when determining minimum gage. So ASA is evidently playing it safe for the time being at least.

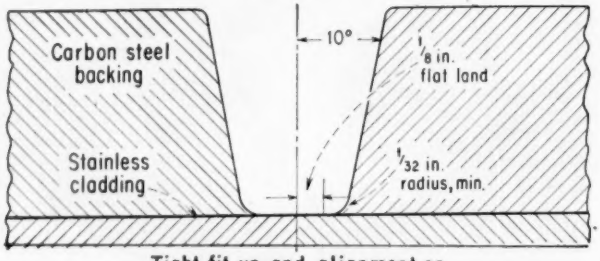
Code approval should boost use of clad pipe. Up to now actual process experience has not been extensive. There is some 30-in. dia., ⅜-in. gage, 20% stainless-clad at an AEC installation. A petroleum company is using 24-in. clad pipe in ½ to 1-in. gages carrying sour crude. Another refinery has some 24 to 36-in. dia., ½-in. gage clad pipe servicing a crude oil tower.

▶**Will Bond Hold?**—This limited experience raises a big question. At high temperatures, stainless expands more than steel (10 in./in./F. x $10^{-6}$ for 304 stainless vs. 7.7 in./in./F. x $10^{-6}$ for 1020 steel at 800 F.). Aren't internal stresses, particularly during temperature cycling, sufficient to break the bond between steel and stainless? The answer, according to work done at Lukens, Franklin Institute and Battelle, is no.

Lukens points to all the clad vessels in service, some going

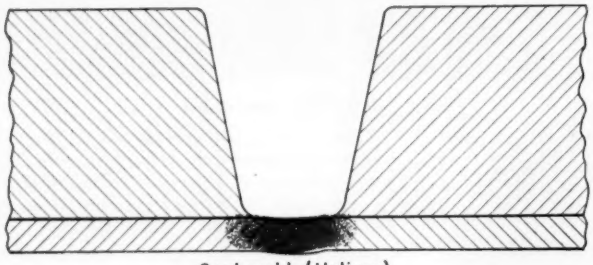
## Key to Joining Clad Pipe: New Welding Technique

### First, Good Alignment Is Vital



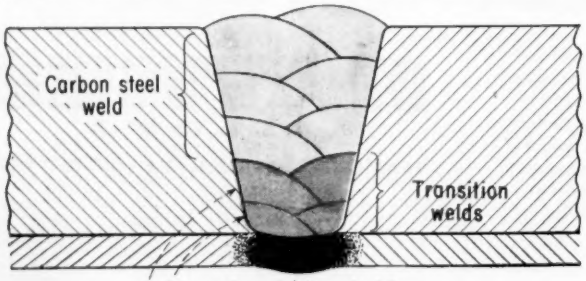

Tight fit-up and alignment on inside surface

### Next, Seal Weld Without Filler Rod



Seal weld (Heliarc)

### Then, Avoid Brittle Carbides Via Transition Welds



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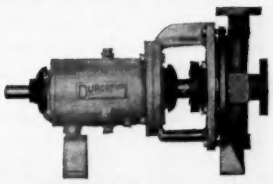

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from room temperature to 1,500 F., back to room temperature, three or four times a day for a number of years without failure. So plant experience is available, at least, on clad-steel plate in process equipment.

Theoretical stress calculations and laboratory tests show that the net effect of high temperatures on a composite plate is not detrimental provided there is a proper ratio of cladding to carbon steel thickness and production procedures are used which produce high bond strengths. Lukens, of course, uses a roll-bonding procedure. Another method, developed by Chicago Bridge and Iron, brazes alloys to carbon steel with vacuum. Both methods give a similar product, with high bonding strengths at the cladding interface.

▶**New Welding Method**—But bonding technique is not the only important factor. The key behind stainless-clad pipe centers around development of a novel welding method.

For large pipe it's no trick for a welder to join sections by first welding the carbon-steel backing on the outside; then crawling inside the pipe, gouging out unfused cladding and finishing the job by welding the stainless cladding with a stainless rod, all on the inside.

You can't do this for pipe smaller than about 24-in. If you try to weld a section of clad pipe completely from the outside, using a carbon-steel welding rod, the weld near the stainless will be weak and brittle: Chromium from the alloy combines with carbon in the steel to produce hard, trouble-causing chromium carbides.

The reverse procedure, stainless welds on steel, produces a relatively ductile, strong joint. And it is possible to use a stainless weld for both the cladding and backing steel. But differential expansion problems between the stainless weld and carbon steel limits this technique to relatively mild conditions or light gage pipe.

The more complete solution is a technique which (a) fusion welds stainless cladding with a nonconsumable electrode (b) provides transition welds above the cladding of low-carbon stainless, then low-carbon steel (c) finishes off the weld with the usual carbon-steel rod. This is all done on the outside of the pipe.

The technique can be applied for circumferential welds in the field, as well as in welding rolled pipe from clad plate during manufacture.†

▶**How It's Done**—A typical procedure for circumferential welds calls for an accurate alignment of two pipe sections (backing metal first beveled to reveal the cladding). Stainless clad is fusion or seal welded via an inert-gas-shielded, nonconsumable tungsten arc (Heliarc). A filler rod is not used during this step. After the seal weld, a layer of low-carbon stainless (Type 308L) goes down either by stick electrode or by inert-gas-shielded methods. Next layer: a weld deposit of a low-carbon, low-hydrogen steel (ingot iron). Carbon-steel weld metal, matching the physical characteristics of the backing material, completes the joint.

This sequence of welds reduces the possibility of chromium combining with carbon, forming brittle alloys. But one disadvantage becomes apparent. Welders have to handle three different welding rods; each rod in proper sequence. The wrong one at the wrong point in the procedure will produce a faulty union.

▶**Fittings Available**—Besides the pipe, Lukens tells *CE* that clad fittings will be available from most fitting fabricators, and, of course, valves of compatible stainless are readily obtainable. Methods have also been developed for flanging stainless-clad pipe with clad slip-on flanges.

The new welding technique, while intended for stainless cladding, can also be used for other materials. Nickel, for instance, doesn't present a chromium carbide problem, but iron-pickup or dilution must be avoided, since it reduces corrosion resistance. Here a transition weld using low-carbon stainless and ingot iron provides minimum dilution of the cladding plus good ductility through the joint.

† Some fabricators have a fixture or carrier for placing a welding torch inside small size pipe for longitudinal welds. Most use the new "outside" technique.

## Titanium Goes Into ASME Boiler Code

You can now have a process pressure vessel made out of titanium with the blessings of ASME.

The Boiler and Pressure Vessel Code Committee of ASME has handed down a special ruling—after three years of study—which, in effect, includes titanium in the Unfired Pressure Vessel Code. This permits construction of heat exchangers, heating coils and tanks without time-consuming and costly special investigations.

The code spells out titanium grades for various applications. And also included are welding requirements, inspection and stress relief procedures, and allowable stress values up to 650 F.

## Britons Form Corrosion Association

A new technical corrosion group has been formed in England, the British Association of Corrosion Engineers, to "promote interchange of technical information and eventually to set up standards of corrosion control."

The group, after getting into full operation, hopes to hold conventions and symposiums.

Address: British Association of Corrosion Engineers, 97 Old Brompton Road, London S.W. 7, England.

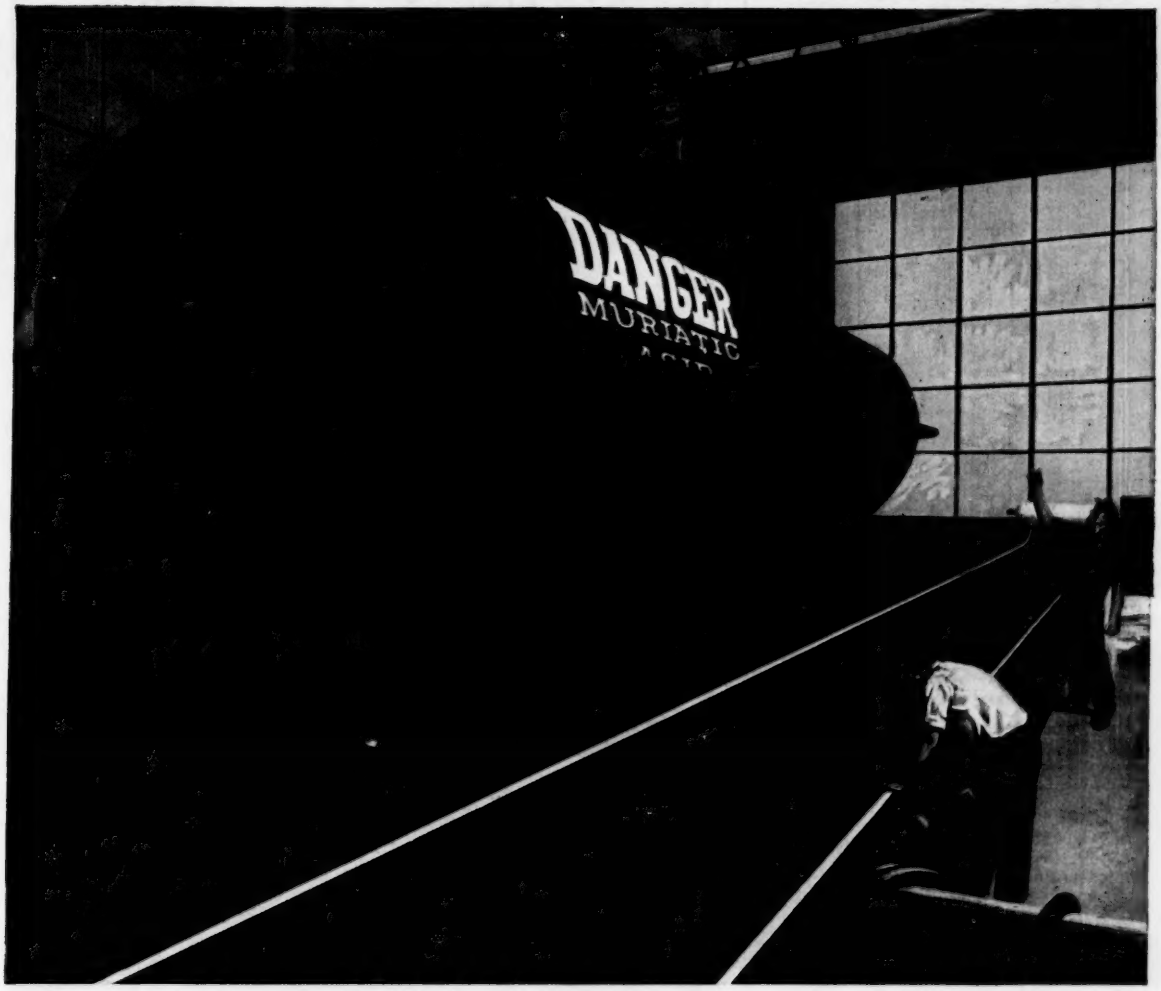
## Battelle Develops New Lead-Cemented Alloys

Battelle Memorial Institute has developed a new group of lead materials which may be very useful in corrosion-resistant applications.

Battelle mixes molten lead with finely-divided solid metals such as cobalt, iron, molybdenum, nickel and tungsten. Product has the corrosion resistance of lead with increased strength due to the metal additives.

Probable applications: high-temperature gaskets, bearings, linings.

US RUBBER PERMOBOND LININGS




# U.S. Permobond Linings protect tank car carrying muriatic acid

Permobond® is the rubber lining that is resistant to destructive chemicals. Here you see it about to be applied to a tank car by U. S. Rubber's local applicator in the New Orleans area—Avondale Marine Ways, Inc.

Any equipment, new or old, requiring protection against corrosive attack, needs Permobond Linings. They protect not only against muriatic acid, but against wet or dry chlorine, saturated chlorine, salt brine, sulphuric acid and other chemicals—and withstand temperatures up to 200°F. New equipment can be Permobond-protected before delivery. You can also have Permobond put on existing equipment. That's why so many corporations in basic chemical manufacturing, chemical processors and steel pickling plants have their equipment, large or small, lined with it. Get in touch with us for Permobond service in your locality.

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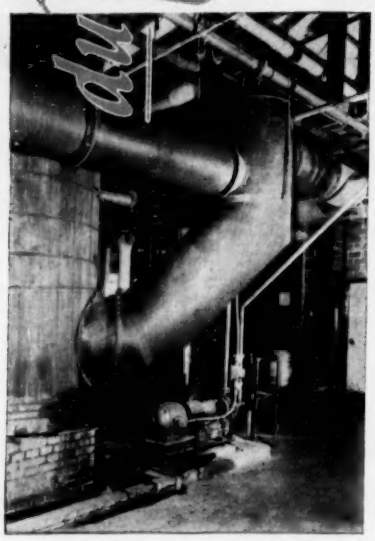
du Verre CORROSION REPORT



**DU VERRE RESIN BONDED FIBER GLASS EQUIPMENT SOLVES A TOUGH CORROSION PROBLEM!**

This 36" diameter du Verre vent assembly installed in a large Eastern chemical plant, replaced a rubber lined duct which failed after only one year's service. Prior to the rubber lined duct, a stainless steel unit failed after only a few months' service. The du Verre duct has been in continuous service for over four years, and shows no signs of corrosion. It has been handling gases containing HBr, HCl, Chlorbenzine and other organic solvents. Since du Verre resin bonded fiber glass is homogeneous in structure, external corrosion which was a problem with the other forms of construction, is entirely eliminated.

du Verre offers a wide variety of resin formulations to provide complete protection under almost any condition . . .

- **#11 offers good acid and solvent resistance at a moderate cost.**
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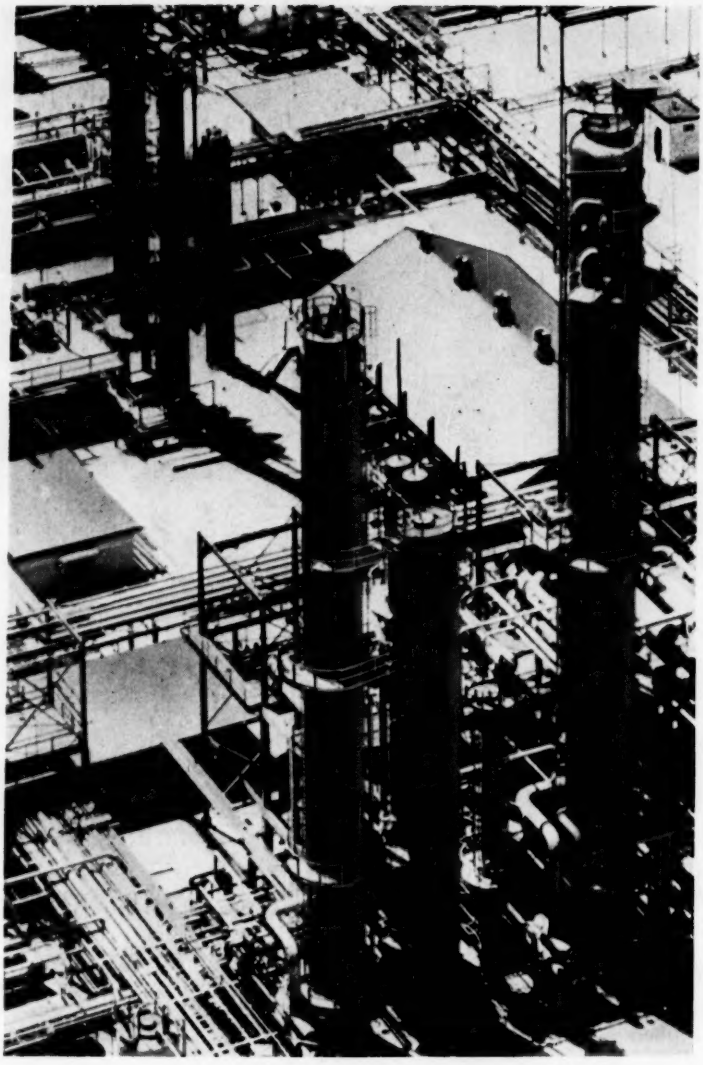
# FIRMS IN THE NEWS

J. A. KING

## NEW FACILITIES



### New Columns to Fractionate Narrow-Range Solvents

**Delhi-Taylor Corp. has completed construction of its new 2,500-bbl./day solvents plant at Corpus Christi, Tex. New plant produces heavy aromatic solvents for the insecticide, herbicide, resin, gum and rubber industries, and lighter solvents, widely used by the paint and varnish industry.**

**American Cyanamid Co.** announces plans for expansion of its nearly completed maleic anhydride plant at Bridgeville, Pa., from 7,000 to 10,000 tons/yr. Plant, now under construction, will go on stream this fall; expansion

will go on stream by the end of the year.

**Phillips Chemical Co.** is increasing its ethylene capacity at Sweeny, Tex., to 320 tons/day. Feed for the chemical plant will continue to come from adjacent Phillips Petroleum Co.'s Sweeny refinery and gas-processing facilities.

**Montecatini** is building its first plant in the U. S., a 5,000-ton/yr. isotactic polypropylene plant at Neal, W. Va. Novamont Corp., wholly owned by Montecatini, will operate the new $10-million facility.

**Continental Oil Co.,** reaching for higher-octane gasolines, is adding an 11,000-bbl./day catalytic reformer to its Lake Charles, La., refinery. New unit to cost $3 million is being constructed by the Bechtel Corp.

**Tidewater Oil Co.** plans expansion of both its Avon, Calif., and its Wilmington, Del., refineries. At Avon, expansion plans include addition of giant catalytic cracking, alkylation and butane isomerization units to cost over $50 million. At Wilmington expansion will be in the $10-million range.

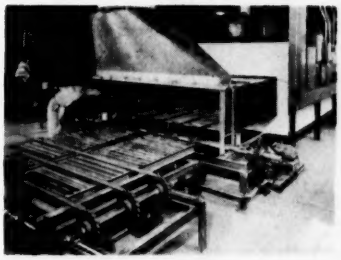
**Heyden Newport Chemical Corp.** announces plans for construction of a 12,000-ton/yr. maleic anhydride and fumaric acid plant at Fords, N. J. Both chemicals are raw materials for alkyd and polyester resin manufacture.

**Shamrock Oil & Gas Corp.** of Amarillo, Tex., has contracted the Fluor Corp. to engineer and construct an 8,000-bbl./day Thermofor Catalytic Cracking unit for its McKee refinery at Sunray, Tex. Construction to begin this summer, is scheduled for completion by next spring.

**International Paper Co.** will make a $13-million addition to its new Pine Bluff, Ark., plant. Addition of a new machine to produce 50,000 tons/yr. of lightweight paper will broaden International's line of products at Pine Bluff, now limited to newsprint and bleached kraft board.

**Chemical Construction Corp.** of New York will construct an 80-ton/day, anhydrous-ammonia plant for Southwestern Nitrochemicals Corp. at Chandler, Ariz. New plant, to cost $4 million, is scheduled for completion by the beginning of next year.

**American Potash & Chemical Corp.** has begun operating its new anhydrous lithium chloride plant at Henderson, Nev. Lithium chloride will be marketed for use in aluminum welding and brazing fluxes, low-temperature batteries, air conditioning and humidification.



**Union Carbide Plastics Co.** is expanding and moving its Vinylfoam producing facilities to a new location in Newark, N. J. Shown above is one of four curing ovens being installed at the new Newark location, each with a capacity of 500 lb./hr. of Vinylfoam.

**Dow Badische Chemical Co.** is constructing a plant to produce acrylic acid and methyl, ethyl, butyl and other acrylic esters at Freeport, Tex. New plant is being built adjacent to Dow Chemical Co.'s Texas Div.

**Consolidated Mining and Smelting Co.** of Canada, Montreal, announces plans for construction of a $20 million iron and steel plant at Kimberly, B. C. Lurgi Gessellschaft, A. G., of Frankfurt will supply the sintering equipment, while Elektrokemisk of Oslo, Norway, will supply the first electric pig-iron furnace.

**General Tire & Rubber Co.** has completed a $350,000 expan-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DURA SEAL

...provides mechanical sealing for the widest range of pressures, temperatures and speeds

Technical information on request—write DURAMETALLIC CORP., Kalamazoo, Michigan

Industry's big **DEMAND** for small valves keeps growing every day. A few years ago, Hoke's old plant was more than adequate... the product line was limited to a handful of styles. But along came nuclear energy and mass spectrometry and automation. So our lines grew and grew.

**HOKE** now manufactures:

**Bar Stock Valves** to handle high pressures

**Packless Valves** to resist corrosion, hold high vacuum

**Metering Valves** to throttle down to a trickle

**Check Valves** to control one-way flow

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Plus many other types, too. And we're not only making more, we're making them faster...with every Hoke Valve leak tested...in our new automated plant.

When you need **QUALITY** small valves, delivered promptly, tell us your requirements. We'll gladly send you our catalog with specific recommendations.


Hoke Incorporated,
39 Piermont Rd., Cresskill, N.J.

HOKE


FIRMS . . .

sion of its Mogadore, Ohio, facility for the production of paint, paper and textile latices. Rising demand for latex-base paints spurred the increase of styrene-butadiene capacity.

**Gulf Oil Corp.** has completed construction of its new 30-million-gal./yr. benzene solvent plant at Port Arthur, Tex. New plant consists of a catalytic reformer and a purification unit. Platinum catalyst converts a hexane-rich stream to benzene-rich solvent.

**Callery Chemical Co.** is negotiating a lease with the U.S. Government for use of part of the Sunflower Ordnance Works. Callery will use the facilities and personnel to undertake advanced development of new rocket propulsion systems for the NASA.

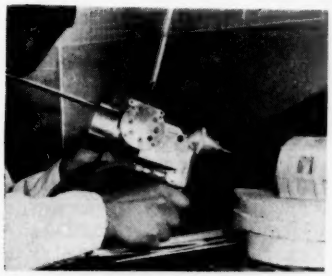
**Stauffer Chemical Co. & Victor Chemical Co.** have reached agreement for merger of the two companies. Victor will operate as the Victor Chemical Div. of Stauffer.

**Celanese Corp. of America** is breaking into the rocket and missile fuel industry, has acquired a plant in Asheville, N. C., for the manufacture of high-energy propellants. New plant will be operated by Amcel Propulsion, Inc., to be owned in part by Celanese.

**Rexall Drug & Chemical Co.** acquired the total assets of Granada Plastics Co. of Saugus, Calif., producer of polystyrene. Granada began operating its 3-million-lb./yr. polystyrene plant early this year.

**Consolidated Beryllium Corp.** was established by The Beryl-

lium Corp. of Reading, Pa., and Imperial Smelting Corp., Ltd., of London. New firm, to be managed by Imperial, will produce nuclear-grade beryllium for European markets.



**Norton Co.** of Worcester, Mass., has licensed Coors Porcelain Co. of Golden, Colo., to employ and relicense its Rokide process. Refractory materials, such as alumina and zirconia and metals, such as steel and aluminum, may be sprayed on many surfaces using the Rokide process.

**Pacific Engineering and Production Co.** is negotiating with Thiokol Chemical Corp. for cooperation in the production of high-energy missile fuels. Pacific recently began production of ammonium perchlorate, an important missile fuel material.

## NEW LINES

**The Cross Co.,** Detroit, Mich., is breaking into the nuclear field, has acquired Stephen F. Malaker Associates, radiation consultants in the chemical and electronics industry.

**Celanese Corp. of America** announces the formation of Celanese Development Co. to evaluate potential marketing areas in Europe.

**National Research Corp.** is breaking into the rocket and missile fuel industry, has li-

**Remote Control of Temperature or Pressure with TRUE Proportional Band Adjustment**

Now, the simplest *true* proportional band adjustment in the field . . . a compact, inexpensive unit for positive remote control of temperature or pressure in countless applications. Fast-response bulb sends three- to fifteen-pound air signal to control valve, damper actuator or other control device. Long-life dependability ends pilot control headaches. Available as "blind" or indicating controller.

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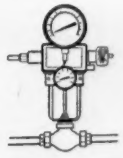
- Any 50° range, −20° F. to +380° F. Pressure: 3-35 psi; 5-75 psi; 15-150 psi.



Can be supplied factory mounted on control valve

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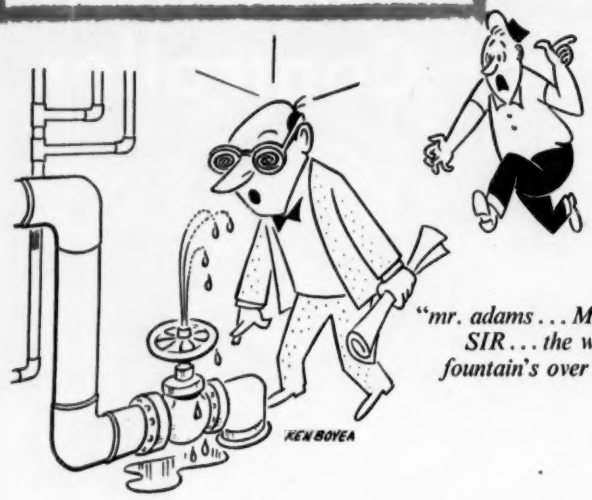
Robertshaw-Fulton
CONTROLS COMPANY

**FULTON SYLPHON DIVISION • Knoxville 1, Tennessee**

**Life in these excited states...**

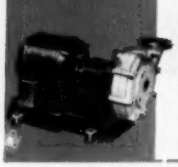



*"mr. adams... Mr. Adams... SIR... the water fountain's over here!"*

# Why men of vision choose ACE equipment

Men with a weakness for profits somehow manage to keep equipment "on stream" full time with no corrosion shutdowns. You'll find they reach for Ace corrosion-engineered equipment time and again. Now nine kinds of Ace pipe ... plus pumps, valves, tanks, and special equipment to solve most any corrosion or contamination problem.

**"WAM" PUMP** *finest you can buy*

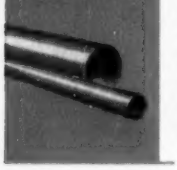


Highest pumping efficiency, with faultless corrosion resistance. Hard rubber casing and impeller; Hastelloy *C* shaft. 80 gpm. *Bul. CE-55.*

**THRIFTY-THROATED VALVES**

Liquids never touch metal in Ace diaphragm valves! Rubber or plastic-lined cast iron, or solid plastic bodies. Sizes ½ to 6". Ask for facts.

**ACE-ITE** *all-purpose toughie*



High-impact, rubber-plastic, most economical for average chemicals. ½ to 6". Screw or solvent welded fittings. Valves ½ to 2". NSF-approved. *Bul. 80A.*

**RIVICLOR** *ageless strength*

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Free Bul. CE-56.*

See our pages in CEC Catalog!

**ACE** processing equipment of rubber and plastics

**AMERICAN HARD RUBBER COMPANY**
DIVISION OF AMERACE CORPORATION
**Ace Road · Butler, New Jersey**


FIRMS . . .

censed its vacuum-processing know-how to Aerojet-General Corp. of Azusa, Calif. The latter plans to produce solid propellants, using NRC's processing techniques.

## OVERSEAS BRIEFS

**Scotland:** Imperial Chemical Industries announces plans for construction of a 2,000-ton/yr. polyester film plant near Dunfries, Scotland. New $8-million plant will eliminate the need for importing U. S. polyester film.

**China's** first modern rayon plant went on stream in Paoting, North China, was designed and constructed with the help of East-German scientists and engineers.

**Netherlands:** Goodyear Tire and Rubber Co. announces plans to construct a $150,000 plant for production of synthetic liquids for textile impregnation.

**China** has completed the first phase of construction of its fertilizer complex in the province of Szechwan. New plant, located near Chengtu, will have a capacity of 240,000 tons/yr. of sulfuric acid, 300,000 tons/yr. of ammonium sulfate and 10,000 tons/yr. of ammonium nitrate when it is completed early next year.

**Japan:** Teikoku Rayon will begin production next month of Taslon, a bulky, new yarn, at its Imae plant in Ishikawa Prefecture. Teikoku licensed the Taslon process from Du Pont.

**Austria:** Danubia Petro-Chemie, A. G., of Vienna is nearing completion of its polypropylene process development. Plans include construction of a 4,500-metric-ton/yr. polypropylene plant in 1962.

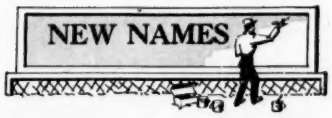
**Switzerland:** Food Machinery and Chemical Corp. is providing process know-how for the expansion of Elfa, Ltd.'s, hydrogen peroxide plant at Aarau, Switzerland.

**Japan:** Yawata Chemical Co. announces plans to build a 3,600-ton/yr. phthalanhydride plant. Yawata will license a process, owned by Chemische Fabrik von Heuden, A. G.

**Colombia:** Borden Chemical Co. announces plans for construction of a 3,500-ton/yr. formaldehyde plant at Cali, Colombia, with facilities for relatively easy doubling of capacity.

**Venezuela:** Reichhold Chemicals, Inc., has formed a new company in Caracas, Venezuela, to produce synthetic resins. New facilities, to be operated by Resinas Venezolanas C. A., will produce polyester and other resins.

**Japan:** Shokubai Kasei Kogyo, K. K., is installing the nation's largest spray dryer, will use it to dry synthetic, fluidbed catalysts at its Wakamatsu City plant. Bowen Engineering Co. of North Branch, N. J., is supplying the dryer.




**Carbic Color & Chemical Co.** has adopted a new name Carbic-Hoechst Corp., with two divisions: Dyestuff Div. and Pigment Div. Carbic-Hoechst will market products manufactured by Farbwerke Hoechst, A. G.

**Hughson Chemical Co.** is the new name of the Special Products Div. of the Lord Manufacturing Co. New name reflects interest in diversification; Hughson will produce metal-surface treating agents, protective coatings and adhesives.


**Life in these excited states...**

*"So you've got some leaks . . . look, new pipe costs money!"*

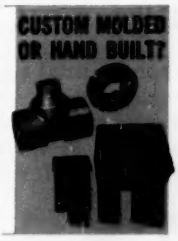
**Troubles coming in waves? Try Ace-Ite pipe**

Ace-Ite Plastic Pipe . . . a tough, chemical-resistant ABS rubber-resin blend . . . is the surest way to stem the tide of corrosion. One of eight types of Ace pipe, it's ideal for general use, handles most chemicals. It's been around long enough so we know what it'll do. And you'll like the price. *Ask for Bulletin CE-80.*

Ace chemical-resistant rubber-lined steel pipe best for high-pressure, big sizes, or abrasives. Pipe, fittings and valves 1½ to 24".

Highly efficient *WE* pump. Capacity to 360 gpm. Cast iron, fully protected by top quality, chemical resistant hard rubber lining.

Design assistance and facilities for molding special fittings, pump parts, etc., of plastics or hard rubber. Also large hand-fabricating facilities.




Variety and quality to match *any* plastic piping. Riviclor PVC, Ace-Ite rubber-plastic, Parian poly, Ace Saran, Tempron high temperature nitrile, hard rubber-lined steel.

**ACE** processing equipment of rubber and plastics

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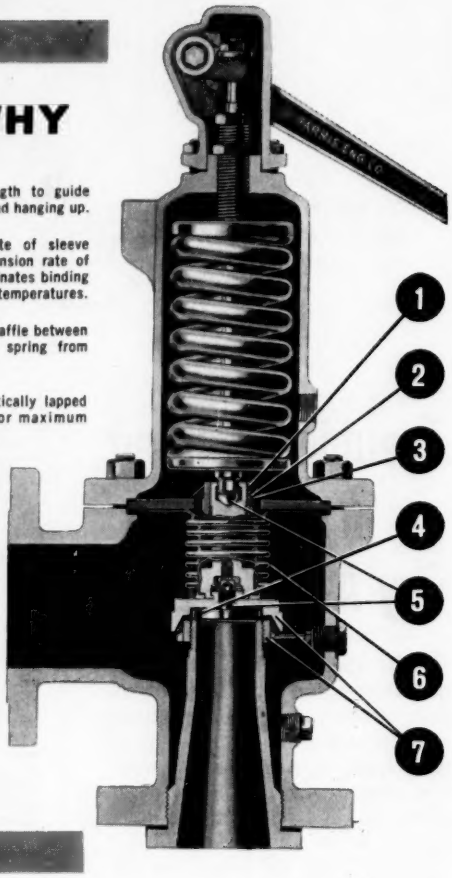
1. 2½ to 1 ratio – guide length to guide diameter–prevents galling and hanging up.
2. High thermal expansion rate of sleeve guide and low thermal expansion rate of hardened stem retainer eliminates binding and galling even at elevated temperatures.
3. Sleeve guide provides solid baffle between body and bonnet, shielding spring from lading fluid.
4. Hardened stainless steel optically lapped flat disc – self aligning for maximum tightness.
5. Double universal ball joint from stem to disc for self alignment – eliminates effects of spring, temperature and piping distortion.
6. Stainless steel "BALANSEAL" bellows nullifies effect of back pressure and isolates internal working parts from lading fluid.
7. Cone-shaped disc holder directs flow away from guiding surfaces and forms fixed secondary orifice with single blowdown ring control for built-in capacity.




## Farris full nozzle Safety-Relief Valves

Simplicity in design, safety in operation ... what more can you ask of a Safety-Relief Valve! The patented design features shown in this Farris valve have been *standard* for more than a decade. It's the ideal concept of a trouble-free, safe, safety valve, free from inventory and design change problems since 1945. It's the *preferred design* in full nozzle safety-relief valves for the process industry.

Detailed information for the selection and sizing of all Farris process safety-relief valves is in Catalog FE-118. Sent to you on request.

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## CALENDAR

**American Rocket Society,** symposium: Gas Dynamics, Northwestern University.
**Aug. 24-26** Evanston, Ill.

**Gordon Research Conference:** Instrumentation, Colby Junior College.
**Aug. 24-28** New London, N. H.

**Combustion Institute,** 8th International Symposium on Combustion, Calif. Inst. of Technology.
**Aug. 29-Sept. 2** Pasadena, Calif.

**Chemical Institute of Canada,** Physical Chemistry Div. meeting, McMaster University.
**Aug. 30-Sept. 1** Hamilton, Ont.

**International Union of Pure and Applied Chemistry,** symposium: Thermodynamics and Thermochemistry.
**Aug. 30-Sept. 6** Munich, Germany

**American Society of Mechanical Engineers,** International Air-Pollution Congress, Statler-Hilton Hotel.
**Sept. 10-11** New York, N. Y.

**Armed Forces Chemical Assn.,** annual meeting, Statler Hotel.
**Sept. 10-11** New York, N. Y.

**American Chemical Society,** national meeting.
**Sept. 13-18** Atlantic City, N. J.

**National Industrial Conference Board,** 7th annual Marketing Conference, Waldorf-Astoria Hotel.
**Sept. 16-18** New York, N. Y.

**Canadian Agricultural Chemicals Assn.,** annual meeting, Chateau Frontenac.
**Sept. 20-23** Quebec City, Que.

**Chemical Market Research Assn.,** conference: Textile Fibers.
**Sept. 20-22** Williamsburg, Va.

**Technical Assn. of the Pulp and Paper Industry,** 14th Paper-Plastics Conference, Edgewater Beach Hotel.
**Sept. 21-23** Chicago, Ill.

**Instrument Society of America,** 14th Istrumentation-Automation Conference, Amphitheatre.
**Sept. 21-25** Chicago, Ill.

**Industrial Nuclear Technology Conference,** Morrison Hotel.
**Sept. 22-24** Chicago, Ill.

**American Rocket Society,** conference on solid propellants, Princeton University.
**Sept. 24-25** Princeton, N. J.

**American Society for Quality Control,** Chemical Div., annual conference, Shamrock Hilton Hotel.
**Sept. 24-25** Houston, Tex.

**International Union of Pure and Applied Chemistry,** 20th conference.
**Sept. 26-29** Munich, Germany

**American Institute of Chemical Engineers,** national meeting, Hotel St. Paul.
**Sept. 27-30** St. Paul, Minn.

**American Oil Chemists Society,** fall meeting, Statler Hotel.
**Sept. 28-30** Los Angeles, Calif.

**American Institute of Mining, Metallurgical and Petroleum Engineers,** Div. of Petroleum Engineers, fall meeting.
**Oct. 4-7** Dallas, Tex.

**Packaging Specifications Conference,** Purdue University.
**Oct. 5-6** Lafayette, Ind.

**American Gas Assn.,** national conference, Conrad-Hilton Hotel.
**Oct. 5-7** Chicago, Ill.

**International Symposium on High-Temperature Technology,** arranged by Stanford Research Institute.
**Oct. 6-9** Asilomar, Calif.

**Society of Plastics Engineers,** Technical meeting: Vinyl Plastics.
**Oct. 7** Cleveland, Ohio

**American Vacuum Society,** annual meeting, Penn Sheraton Hotel.
**Oct. 7-9** Philadelphia, Pa.

**Assn. of Agricultural Chemists,** annual meeting, Shoreham Hotel.
**Oct. 12-14** Washington, D. C.

**Technical Assn. of the Pulp and Paper Industry,** engineering conference, Penn Sheraton Hotel.
**Oct. 12-15** Pittsburgh, Pa.

**Western Agricultural Chemicals Assn.,** fall meeting, Villa Hotel.
**Oct. 13-14** San Mateo, Calif.

**Society of Plastics Engineers,** technical conference, Ambassador Hotel.
**Oct. 13-14** Los Angeles, Calif.

**Natural Gasoline Assn. of America,** southern meeting, Carlton Hotel.
**Oct. 16** Tyler, Tex.

**American Production and Inventory Control Society,** annual technical conference and exhibit, Hotel New Yorker.
**Oct. 16-17** New York, N. Y.

**International Fair of the Plastics Industry,** Europe Hall.
**Oct. 17-25** Dusseldorf, Germany

**American Coke & Coal Chemicals Inst.,** annual meeting, Greenbrier.
**Oct. 19-20** White Sulfur Spa., W. Va.

**American Standards Assn.,** national conference, Sheraton-Cadillac Hotel.
**Oct. 20-22** Detroit, Mich.

**National Agricultural Chemicals Assn.,** national meeting, Sheraton Lick Hotel.
**Oct. 21-23** French Lick, Ind.

**National Lubricating Grease Institute,** annual meeting, Roosevelt Hotel.
**Oct. 26-28** New Orleans, La.

**Independent Petroleum Assn. of America,** annual meeting, Statler-Hilton Hotel.
**Oct. 26-27** Dallas, Tex.

**American Institute of Chemical Engineers,** New York Section, annual symposium, New Yorker Hotel.
**Oct. 27** New York, N. Y.

**Canadian Chemical Specialties Manufacturers Assn.,** annual meeting and convention, Royal York Hotel.
**Nov. 2-4** Toronto, Ont.

**American Society for Metals,** annual exposition and congress, International Amphitheatre.
**Nov. 2-6** Chicago, Ill.

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FLEXIBILITY of operation, providing ANY COMBINATION of products, liquid or high pressure gas PLUS simultaneous production of BOTH oxygen and nitrogen delivers maximum yield of combined products at minimum cost of operation with little operator's attention. Packaged design requires minimum of installation cost and space.

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(*Continued from p. 90*)

to insure tightness and dimensional stability.

Called Extrud-Lock grating, the product is suitable for platforms, scaffolds and catwalks. Extrud-Locks are 6 in. wide in any specified length; thicknesses are 1, 1¼ and 1½ in. Load carrying capacity is 350 lb./sq. ft.—**Read Standard Div., Special Products, York, Pa. 90E**

## Pipe Cutter

**Maintenance item cuts 24-in. pipeline cleanly.**

Easy portability, fast one-man operation and clean, accurate cuts are features claimed for a new line of rotary pipe cutters. Designed for steel and cast iron pipe in sizes from 12 to 24 in., the cutter is especially suited to pipeline maintenance and repair.

All models consist of a separable circular frame joined at the midsection by hinged screws and adjusting nuts. An aluminum handle placed successively over eight lugs on the outside of the frame turns the cutter. The same handle tightens the device as cutting proceeds in manner similar to small pipecutters.

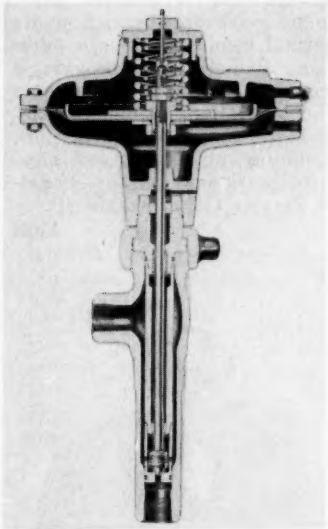
Application requires only a minimum of digging because four-wheel design requires no more than 45 to 60 deg. of handle swing, and only a 6- to 8-in. channel beneath the pipe.—**Reed Mfg. Co., Erie, Pa. 176A**

## Dock Valve

**Rest hose on lugs, insert gasket and secure.**

According to the manufacturer, a new cast steel valve meets the need for an easier and more practical method of connecting cumbersome flexible tanker or barge hoses to manifold valve flanges. In the past, such a connection required muscular strength and coordination—flanges had to be manually aligned while a gasket was inserted between mating parts, and while bolts and nuts were tightened.

With the new valve, workmen rest the heavy hose flange on a number of lugs extending beyond the lower lip of the stationary valve flange face. With hands freed, the workmen can then easily place the gasket between the flanges and insert the bolts. Or, to further simplify the operation, specially designed clamps, which are optional, eliminate the necessity of aligning holes or the use of bolting.—**Kerotest Mfg. Co., Pittsburgh, Pa. 176B**



### Dump Valve

**Heat absorption from vessel gas stops freezing.**

Type 125 Anti-Freeze control valve is designed for liquid-dump service on high-pressure oil and gas separators, and other processing vessels. Elongated angle body style retards freezing action by absorbing heat from the gases at the top of a vessel. Instruments such as intermitters, pressure controllers and level controllers regulate valve operation.

Material of construction for the body is cast steel; pressure rating is 3,000 psi. (WOG). Vessel coupling connection is 2-in. male NPT; inlet and outlet connections are 1-in. female NPT. Internal component arrangement assures correct alignment, adequate strength and straightforward assembly. **—Fisher Governor Co., Marshalltown, Iowa. 177A**

### Calculator

**Free device aids estimation of tank capacity.**

Handy and simple to use, a time-saving tank-capacity calculator enables plant personnel to quickly estimate content volume of vertical vessels. Scales are graduated in bushels, gallons and barrels. The calculator


The big swing is to
FLO-CHILLED CAUSTIC

It's the caustic soda from Wyandotte that *never* lumps or cakes because it's *Flo-chilled* to flow freely in your automatic machinery *every* day of the year — no matter *what* the weather. And Wyandotte *Flo-chilled** Anhydrous Caustic Soda costs no more than ordinary caustic!

Try it out for yourself. Call your Wyandotte representative or distributor *today* for a supply of Flo-chilled caustic! *TRADEMARK

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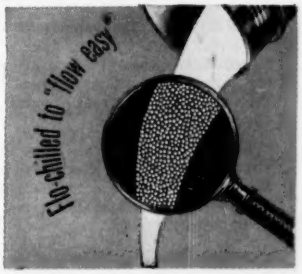


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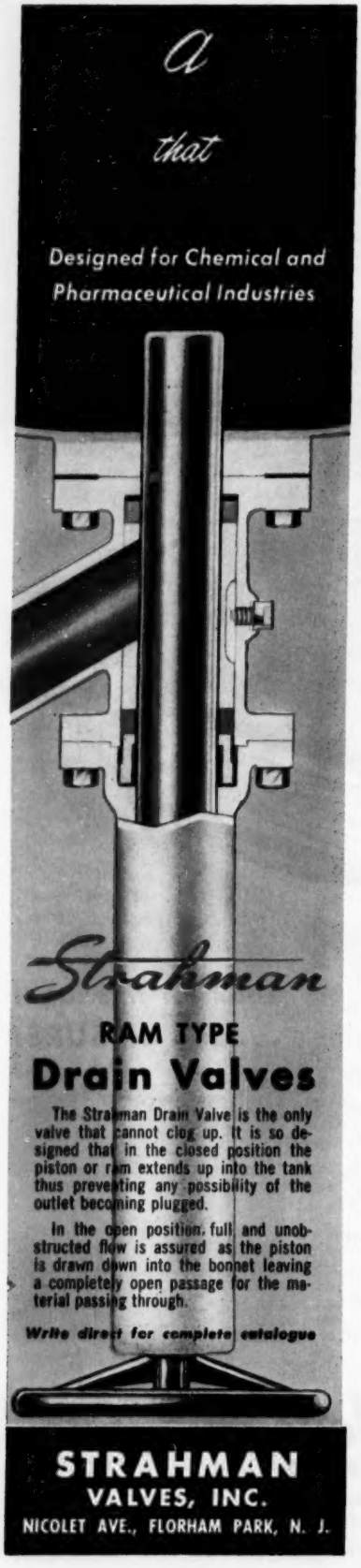
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is applicable to vessels ranging in height from 5 to 100 ft. Available free on request.—**Solar Chicago, Div. U. S. Industries, Inc., Chicago, Ill.** 177B

## Signal Horn

**Fits into any 4-in. electrical outlet box.**

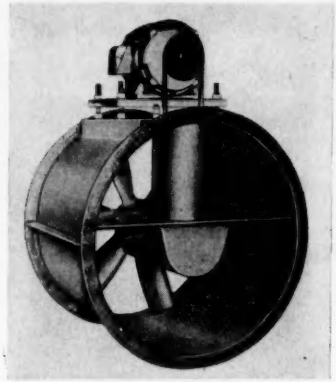
Laboratory tests in the manufacturer's anechoic chamber indictate that a new vibratory horn of advanced design outperforms all previous vibratory-horn designs in existence. Sound can be adjusted from a barely audible buzz to an attention-commanding 101 to 103 decibels at 10 ft.

Known as Vibratone, the basic horn unit fits into any 4-in.-square electrical outlet box. Three models are available: grille type for offices, single-projector style where the alarm must be megaphoned at longer ranges, and double- projection for two-directional distribution. Each model mounts in six different ways, from surface to flush.—**Federal Sign and Signal Corp., Chicago, Ill.** 178A

## Instrument Service

**Can provide specialists and program supervisors.**

Panellit Service Corp. offers a staff of 75 instrument specialists to completely repair, calibrate and modify instrument systems during plant shutdowns, reopenings, turnarounds, etc. Use of these specialists permits a firm to save money by carrying a smaller year-round work crew scaled to its normal requirements. In addition, Panellit can provide a complete team of supervisors and specialists to handle complete instrumentation programs, including pipefitting and electrical work as required.—**Panellit Service Corp., Skokie, Ill.** 178B



## Duct Fans

**Low-cost units resist corrosive materials.**

A new line of glass-fiber, belt-drive duct fans equals or exceeds performance of all-stainless or all-Monel units in most corrosion services, and at substantially lower costs, says the manufacturer. Propeller, duct section, drive housing and bearing cover have glass-fiber construction; drive shaft and hardware are made of stainless steel.

In design and operation, the new line is identical to the manufacturer's standard fans, and offers the same features, including variable-pitch drives for easy adjustment of speed. Diameters offered are 20, 24 and 38 in.—**Hartzell Propeller Fan Co., Piqua, Ohio.** 178C

## Air Cleaner

**Condenses vapor and traps entrained liquids.**

Refrigifilter, a new refrigerated device, safeguards pneumatically operated equipment from all forms of moisture, oil

and other contaminants. The unit is especially designed for locations where cooling water is unavailable, or where ambient day-night temperatures vary a great deal.

In operation, Refrigifilter lowers the dew point of compressed air to approximately 35 F. at pressure, thus condensing out over 90% of all vapors, while at the same time removing all entrained liquids. The unit is rated at 100 scfm. at 100 psig. and 100 F. It combines a heat exchanger, evaporator, refrigeration section and filter element in one compact package.—**Hankison Corp., Canonsburg, Pa.** **178D**

**Sump Pumps**

**Two manufacturers introduce new models.**

Offered in capacities from 15 to 700 gpm., Deming's new sump pump-motor combination (shown above) can be lowered quickly into a pit for temporary service, or permanently installed for continuous duty. The motor is totally sealed and oil-filled in a cast iron case; both pump and motor shaft are made of stainless steel.

Called the Demersible, the pump has a semi-open impeller with a precision bore for perfect alignment. Heavy-duty ball thrust bearings are self-lubricated. Base and strainer come

NEW!

LECTRODRYER® BUDGET AIR DRYER

*supplies small quantities of dry air at low cost*

If your requirements for very dry air are relatively small—but highly important—you'll find the new Budget Air Dryer tailor-made for your needs. An investment in large equipment is not needed. The Budget Dryer is modestly priced, easily installed and serviced, operates on any 110 volt a.c. line.

**NEW BUDGET DRYER IS IDEAL FOR:**

- air-operated instrument controls
- electronic equipment
- small cubicles
- pilot plant operations

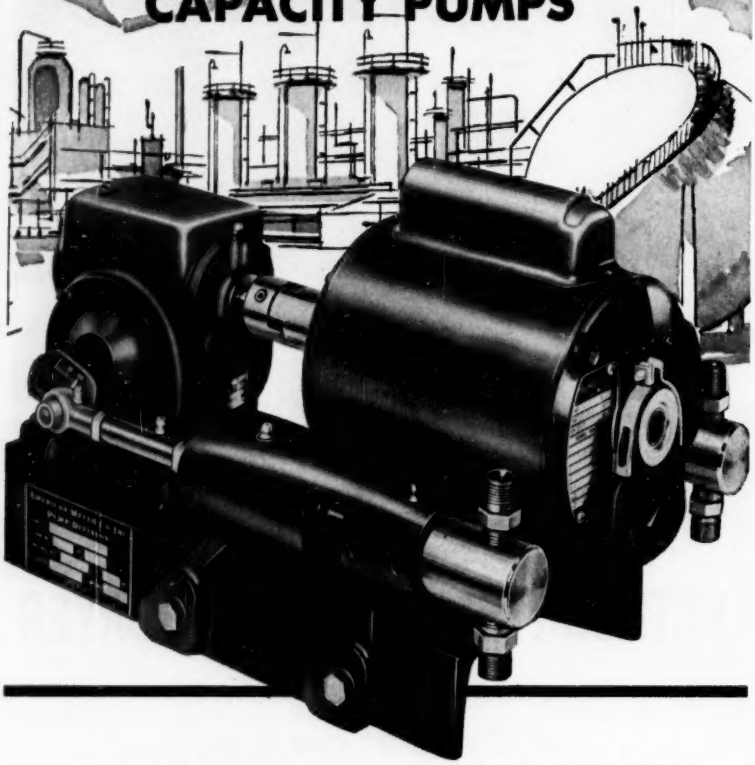
This entirely new unit supplies up to 20 cubic feet per minute of air, dried to a dewpoint of −60°F or lower. Operation is completely automatic. Likewise, the unit is as foolproof as possible, operating independently of variations in air pressure. Rugged construction and a long operating cycle assure trouble-free use.

Lectrodryer Budget Dryers are standard units, available from stock, shipped ready for installation. For complete information on this new unit and its low cost, write for Bulletin B6A, Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd St., Pittsburgh 30, Pa.

Lectrodryer McGRAW EDISON

# NEW

## AMERICAN CONTROLLED CAPACITY PUMPS



### JOB ENGINEERED FOR LONG-TERM ACCURACY AND LOWEST MAINTENANCE COSTS

New American controlled capacity pumps are precision built to meet the needs of Chemical Processing, Refining and Boiler Feed applications. Quality construction assures highest accuracy in feeding precisely metered fluids or slurries into low or high pressure systems in virtually all desired ratios, with flow, temperature, pressure, conductivity, PH and other controlled process variables. Control may be manual or automatic—with electric, hydraulic or pneumatic systems.

Newly designed models are available to handle a wide variety of "tough," corrosive and viscous materials.

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PUMP DIVISION

American meter company

High Pressure Pumps • Controlled Capacity Pumps • Chemical Feed Systems

13500 Philmont Avenue, Philadelphia 16, Pennsylvania




in high-grade cast iron. Float for electrode controls is available.—**The Deming Co., Salem, Ohio**

Another new line of vertical sump pumps features casing liners and runners made of soft rubber. These parts wear up to six times longer than steel parts in abrasive-materials service. Antifriction ball bearings and a marine-type rubber bearing on the shaft reduce horsepower requirements.

Units of the line can handle acids or abrasive pulps, and operate in sumps up to 12 ft. deep. Capacities range from 20 to 1,400 gpm. in pump sizes to 6 x 6 in.—**Denver Equipment Co., Denver, Colo.** 179A

## BRIEFS

**Microdosimeter system** for the measurement of x-ray and gamma radiation provides accurate results in the 10- to 10,000-rad range. Small size of the detector makes implants feasible. And the system allows individual as well as cumulative dose readings over extended periods of time. Price is $1,975.—**Bausch & Lomb Optical Co., Rochester, N. Y.** 180A

**Gas ballast high-vacuum pump** utilizes an adjustable vent to eliminate undesirable vapors from a vacuum system. Model 150 is ideally suited for vacuum systems when it is difficult to trap vapors with conventional cold traps. An additional feature shuts off gas ballast so that the unit may be used as a conventional pump.—**Precision Scientific Co., Chicago, Ill.** 180B

**Centrifugal pumps** designed to handle abrasive slurries are offered in sizes ranging from 2 to 6 in. Type RX pumps feature a low-pressure stuffing box and 4-bolt accessibility for easy maintenance. Wearing parts are reached without disturbing piping; rotating element is adjustable to compensate for wear. Liners on both sides of the impeller are renewable.—

**Morris Machine Works, Baldwinsville, N. Y.** 180C

**Special pump** handles low-temperature liquids, such as liquid oxygen at −297 F. The new pump is one of manufacturer's standard models with special modifications.—**Worthington Corp., Harrison, N. J.** 181A

**Calculator** solves complex problems involving concentration of buffer solution. It eliminates time-consuming logarithmic computations with scales that can be read directly to the second decimal place. Known as the Graphic pH Calculator, the device works for simple electrolytes or for polyelectrolyte mixtures of any degree of complexity. Price is $4.85.—**Graphic Calculator Co., Chicago, Ill.** 181B

**Butterfly valve** with a rubber seat is offered for 150-psi. shutoff service in sizes 4 through 20 in. A wide range of material trim and valve actuators is available for each of the valves in the new line.—**Henry Pratt Co., Chicago, Ill.** 181C

## Equipment Cost Indexes . . .

| | March 1959 | June 1959 |
|---|---|---|
| **Industry** | | |
| Avg. of all | 232.6 | 234.2 |
| **Process Industries** | | |
| Cement mfg. | 225.8 | 227.9 |
| Chemical | 233.7 | 235.7 |
| Clay products | 219.4 | 221.5 |
| Glass mfg. | 220.7 | 222.5 |
| Paint mfg. | 224.4 | 226.6 |
| Paper mfg. | 225.2 | 227.1 |
| Petroleum ind. | 229.2 | 231.4 |
| Rubber ind. | 232.0 | 234.3 |
| Process ind. avg. | 230.1 | 232.8 |
| **Related Industries** | | |
| Elec. power equip. | 236.5 | 246.7 |
| Mining, milling | 235.2 | 237.1 |
| Refrigerating | 262.2 | 264.7 |
| Steam power | 219.7 | 221.8 |

Compiled quarterly by Marshall and Stevens, Inc., of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124—6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.


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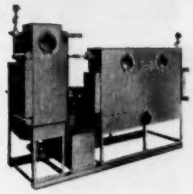
*Give these advantages to specifying engineers:*



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*Reduce dew point of air from 72 F to 46 F with 85 F water! No over-cool & re-heat costs. Kathabar lets refrigeration handle sensible cooling only (sensible, economical). Deliver consistent gr./lb. and DB for process, storage, testing in weatherability testing... powdered drugs and chemicals... rubber testing...plastics... bagging petrochemicals.*

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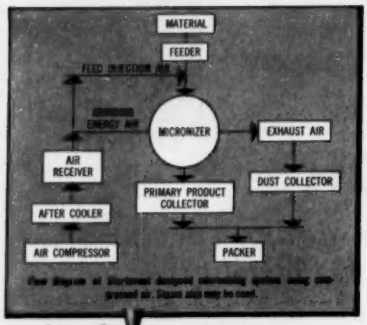
**Sturtevant Micronizers* Make 325 Mesh Obsolete**



**One Operation Reduces, Classifies**

Sturtevant Micronizers grind and classify in one operation in a single chamber—provide fines in range from ½ to 44 microns to meet today's increased product fineness needs. Can handle heat-sensitive materials.

*Production Model (15 in. chamber)*

**No Attritional Heat**

Particles in high speed rotation, propelled by compressed air entering shallow chamber at angles to periphery, grind each other by violent impact. Design gives instant accessibility, easy cleaning. No moving parts.

**Classifying is Simultaneous**

Centrifugal force keeps oversize material in grinding zone, cyclone action in central section of chamber classifies and collects fines for bagging. Rate of feed and pressure control particle size.

**Eight Models Available**

Grinding chambers range from 2 in. diameter laboratory size (½ to 1 lb. per hr. capacity) to large 36 in. diameter production size (500 to 4000 lbs. per hr. capacity). For full description, request Bulletin No. 091.

**Engineered for Special Needs**

A 30 in. Sturtevant Micronizer is reducing titanium dioxide to under 1 micron at feed rate of 2250 lbs. per hr. For another firm, a 24 in. model grinds 50% DDT to 3.5 average microns at a solid feed rate of 1200-1400 lbs. per hr. A pharmaceutical house uses an 8 in. model to produce procaine-penicillin fines in the 5 to 20 micron range. Iron oxide pigment is being reduced by a 30 in. Micronizer to 2 to 3 average microns.

Sturtevant will help you plan a Fluid-Jet system for your ultra-fine grinding and classifying requirements. Write today.

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PEOPLE . . .

# TECHNICAL BOOKSHELF

J. B. BACON

**Interested in 10,000 K. for half a millisecond?**

## On the Combustion Front

SEVENTH SYMPOSIUM (International) on COMBUSTION. Compiled by The Combustion Institute. Butterworths Scientific Publications, London; Academic Press, New York. 959 pages. $35.

Shock tubes are symbolic of a field where more and more chemical engineers are venturing, where a staggering amount of information is published every year. (You're looking into the business end of a shock tube above. For a look at what shock tubes can do, see *Chem. Eng.*, June 15, 1959, pp. 78-80.)

The field is combustion, and the International Symposium on Combustion is a clearing house for one of the most comprehensive collections of papers in the scientific and technical world.

This volume of the Seventh International Symposium (handsomely printed and bound in the tradition of earlier volumes) contains 124 papers, many of which will interest chemical engineers.

For some, the book will be indispensable. But at a price of $35, it is a candidate primarily for university and company libraries.

Papers are grouped under 11 headings: Mechanism of Combustion Reactions, Spectroscopy of Flames, Ionization in Flames, Structure and Propagation of Flames, Ignition and Limits of Inflammability, Interaction of Flames and Surfaces, Turbulence in Flames, Combustion in Practical Flowing Systems, Detonation and its Initiation, Special Fuels, Instrumentation in Combustion Research.

The book contains remarks in a scientific vein by Cyril Hinshelwood and Bernard Lewis.

Of whimsical interest is J. W. Linnett's remark in the introduction:

"In one of these sessions it was encouraging to note that contributions were made . . . by a theoretical physicist, chemists, and an engineer. It was perhaps less encouraging to find that the pure scientists could not answer the query of the engineer."

So, fellow engineers, brush up on the operation of shock tubes.
—JBB

## BRIEFLY NOTED

FLAMMABLE LIQUIDS CODE, NFPA Standard No. 30. *62 pp. National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.* 60¢. 1959 revisions; provides guide to safe practices in storage and handling of gasoline and other flammable liquids.

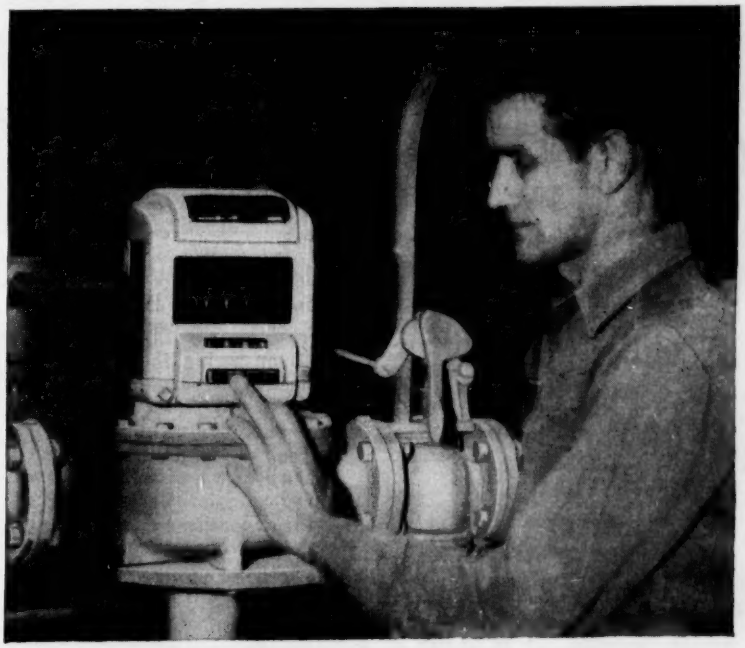
FLOW OF BULK SOLIDS, PROGRESS REPORT. *31 pp. By A. W. Jenike, P. J. Elsey and R. H. Woolley. Bulletin No. 96 of Utah Engineering Experiment Station, 207 Mines Bldg., University of Utah, Salt Lake City 12, Utah.* $1. Gives results, with discussion, of experimental work on flow properties of bulk solids, and relation between flow properties and design criteria for bins.

## MORE NEW BOOKS

SOVIET REVIEWS OF NUCLEAR SCIENCE. Edited by E. Bretscher and D. J. Hughes. Pergamon Press. $5.

ENGINEERING AND ORGANIZATION. By Everett Laitala. Richard D. Irwin, Inc. $7.50.

CONCISE DICTIONARY OF SCIENCE. By Frank Gaynor. Philosophical Library. $10.

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1. Measure water into dry clay to make 55% slurry
2. Add water to cut slurry to 15% ... measuring *both* 55% slurry and water with meters
3. Meter 15% clay slurry directly into furnish at fourdrinier machine
4. Meter both 15% slurry and water to reduce it to 2% clay content for beaters
5. Measure water into starch cooker for accurate 20% mix
6. Meter hot 20% starch into mixer (photo above), also metering in water for accurate dilution to 8%

It's all done with the Neptune Auto-Stop... the push-button meter that automatically shuts off at the exact quantity. Can save *you* time, materials and money, too.

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*Ask for helpful Meter Data Bulletin 566 E See Neptune Data Pages in Chemical Engineering Catalog.*

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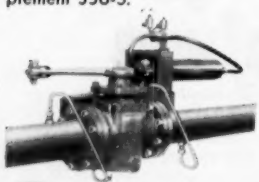
Remote control stations with port position indicating lights can be supplied as required.

For hazardous locations, explosion proof accessories can be furnished.

Actuators are mounted directly on the valve—brackets or bracing from adjoining pipe or building is not required. Linkage to valve stem is direct through couplings or levers—clumsy rack and pinion gearing not needed.

For complete description, details and dimensions, send for our new catalog supplement 356-S.



CYLINDER TYPE

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PEOPLE...

# LETTERS: PRO & CON

C. H. CHILTON

## This Is Better English?

*Sir:*

Upon seeing the You & Your Job title in your April 20 issue—"Here's 'A New Way to Better English'"—I mentally prepared myself for another fine contribution to the chemical engineering profession along the lines of previous issues. After I finished reading—even allowing for the fact that you are quoting someone else—all I could say was "Ugh!"

In one fell swoop (a cliche, albeit) you give credence (pompous?) to the doctrine that if enough people do or say something wrong, then that something becomes right. Unfortunately, the number of people subscribing to this view is legion. They include communists, tax dodgers, speeders and crooked politicians.

One corollary of this belief is a continual degradation of principles to an ultimate mediocrity or chaos. To paraphrase Sir Winston Churchill, "This is something up with which all intelligent individuals should not put."

English is one of the hardest languages to learn simply because of its lack of consistent rules. I feel very strongly that what the English language needs most of all is a better set of rules, rather than creation of more exceptions by ignorant, stupid, illiterate or lazy people.

Some of the simplifications advocated by Flesch are certainly good because they relate to arbitrary rules that apply only to special cases. The split infinitive is a good example of this. However, acceptance of "these kind of" is hard to understand because it violates a general rule—a singular noun takes a singular adjective.

I don't mean to imply that all of what Flesch says is incorrect and undesirable. But I emphatically disagree with accepting changes in the language which are brought about through ignorance, just as I would not accept use of the terms "entropy" and "enthalpy" interchangeably because some people do not have a clear picture of the difference between them.

GERRY LESSELLS
Sharonville, Ohio

*Sir:*

I am glad my article (Apr. 20, pp. 188-194) got so much attention.

But I was rather surprised by the sharp reactions you got from some of your readers. Usually this sort of criticism comes from literary people rather than engineers. I would have expected that engineers, of all people, would have more understanding of the strictly scientific approach to language.

The giveaway, it seems to me, is the word "mediocre" that occurs in several of their letters (June 1, pp. 162-164, June 15, pp. 244-247). It is certainly not a scientific word, but rather a term of snobbery. Would those readers speak of a "mediocre" chemical formula or a "mediocre" alloy? I doubt it. Then why can't they be scientific when it comes to language?

RUDOLF FLESCH
Dobbs Ferry, N. Y.

*Sir:*

The rash of letters to the editor assailing Rudolf Flesch made me wonder. Didn't any of your readers like the article? Or were they just too lethargic to speak up and say so?

Anyway, I liked it. Furthermore, I got the book, read it through, and liked that too. Not that I agree with everything Dr. Flesch says. But I do feel—and strongly too—that any advice is good that will jolt the engineer out of his jargon-filled, incomprehensible rut. Maybe it takes shock tactics to wake up some of us and get us to take another look at our writing habits.

Here is a perfect example of the sort of thing Dr. Flesch is campaigning against. It's not a joke; it's a perfectly serious

piece of writing and was published as such:

"While the imparting of a beneficial effect in respect to resistance to corrosion by the inclusion of zinc is somewhat open to question, there is no persuasive evidence that any notably deleterious effect is caused by so modifying the alloy."

Dr. Flesch's book is not aimed particularly at engineers or technical writers. But it does have a lot of good advice that we should take to heart. By applying his principles to our technical writings, we can greatly improve our communications without being either lazy or sloppy. Come to think of it, you can't be lazy and write like Dr. Flesch. It's hard work! But it's worth the effort.

HOWARD M. MATHIS
Altadena, Calif.

► *Besides the many letters critical of Dr. Flesch have come some like this one which show a due appreciation for what we were trying to accomplish by publishing Dr. Flesch's article in the first place.* —ED.

**Pump Packing Problems**

*Sir:*

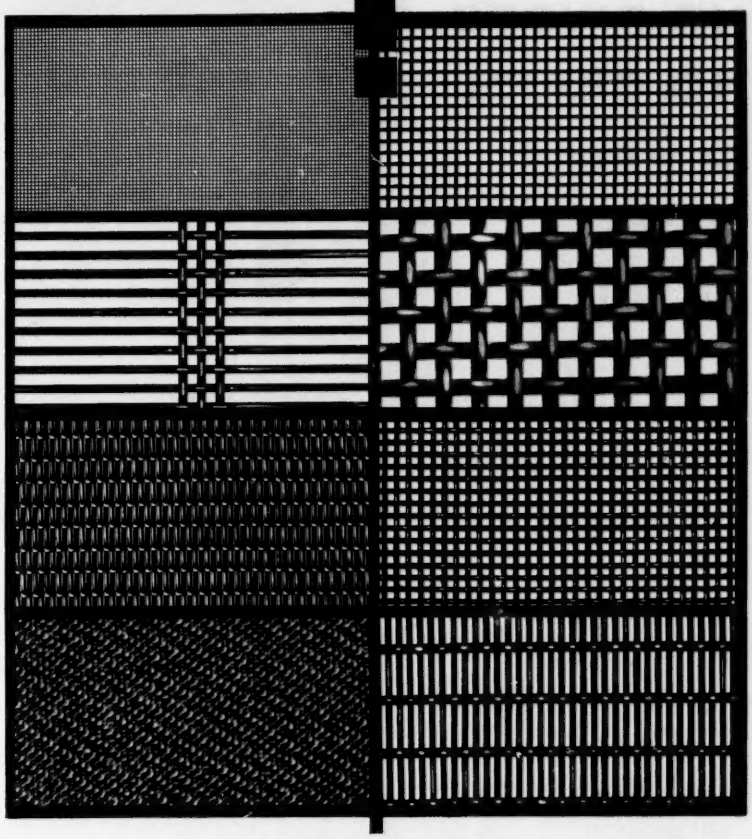
After reading the otherwise excellent article, "How to Extend Centrifugal Pump Life" (June 1, pp. 128-132), I rather wished that Mr. Heaps had avoided reference to packing.

While I agree that good packing performance is very important in extending pump life and that "packings need lubrication," I question whether the comments in the article will be very helpful in obtaining either objective. There are too many qualifications.

There is much need for improved performance of soft packing, but it will never be obtained by adhering to the antiquated stuffing-box arrangement which uses a solid lantern ring. With this arrangement it simply is not possible to provide lubrication where it is needed unless there is some leakage. If there is leakage, then there is trouble.

Several months ago I received a letter from a professor in the Netherlands which said: "During my last year's visit to the U. S. I called on several packing manufacturers. I found that


Do you have a filtering, straining or sizing operation ? Do you make a product for sizing, filtering, straining



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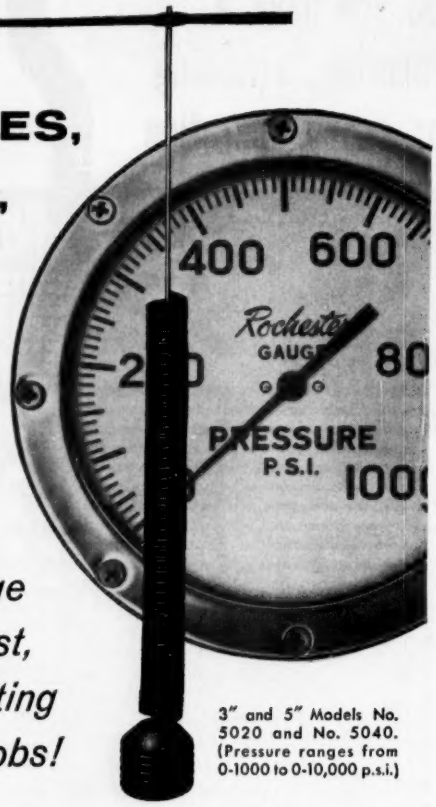
**NO LINKAGES, NO PIVOTS, NO GEARS to wear, waver or lag**




*This is the gauge for your toughest, your most exacting high pressure jobs!*

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these gentlemen specialize in selling packing, not in testing it." The letter identified some of our largest, and presumably best, packing manufacturers.

If Mr. Heaps' article serves no other purpose, it should emphasize the need for a different approach being made to really improve packing performance instead of just doing the same old things that have been done since the invention of the stuffing box.

WALTER COOPEY
Engineering Consultant
Charleston, W. Va.

▶ *Mr. Coopey has written several articles for us dealing with problems of shaft seals. His article on "How to Solve Soft Packing Problems" (Jan. 27, 1958, pp. 131-134) really hit home with many readers. Just the other day we heard that a large chemical company has had Mr. Coopey's spring-loaded packing arrangement in service on two autoclaves for more than a year. Packings have required no adjustment whatever. Previously it had been necessary to adjust packings at least twice a day and then replace them every week.*—ED.

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WALTER E. LOBO
Consulting Chemical Engineer
New York, N. Y.

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R. H. M. SIMON
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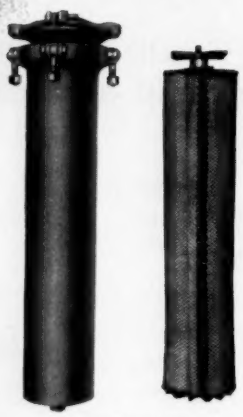

Fig. 1116HA-4L

## STAR-SHAPED EXTENDED AREA STRAINERS

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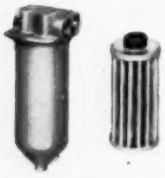

Strainer Fig. 1490AM-O uses Fig. 1490AW-O basket. Rated for 50 psi working pressure. Capacities: 12-25 GPM. 100 mesh or coarser.

Fig. 1490W-4R, 4S and 4L are high pressure strainers rated for 600 psi working pressure. Use Fig. 1490CN baskets of corresponding size. Capacities: 65-468 GPM. 100 mesh or coarser.

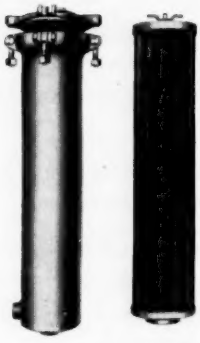

Fig. 1490DD-4L strainer uses one 1490CN-4L basket. Sizes 4R and 4S are same style. Larger sizes available. 125 psi working pressure. Capacities: 65-7500 GPM. 100 mesh or coarser.

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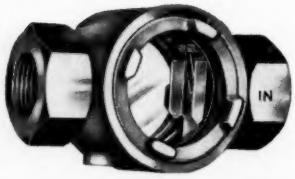


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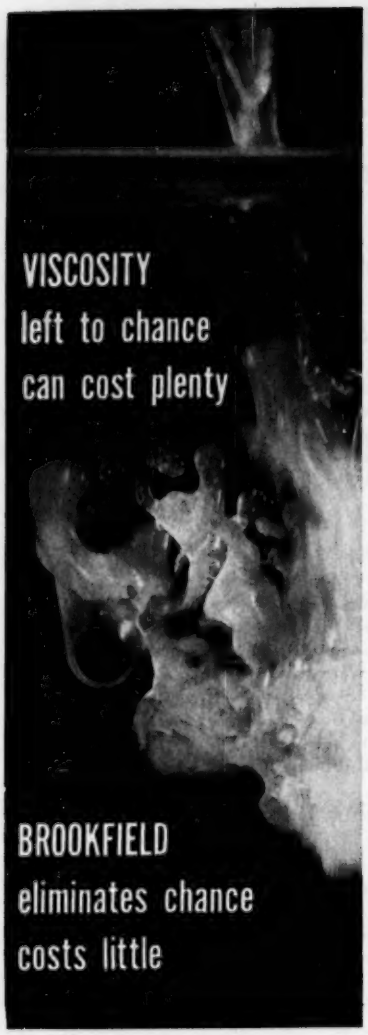


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I. S. A. SHOW SEPTEMBER 21-25TH

READER SERVICE . . .

# TECHNICAL LITERATURE

E. M. FLYNN

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## Chemicals

**Acrylate Esters**.....Methyl, ethyl & butyl acrylates . . . as well as vinyl acetate are available in commercial quantities. Information on acrylate esters & other monomers.
73 *Celanese Corp., Chemical Div.

**Activated Carbon**.....Booklet describes the types & various applications of activated carbons, in both liquid & vapor phase adsorption. Available now.
51 *Pittsburgh Coke & Chem. Co.

**Antifoam, Silicone**.....for all non aqueous systems—SAG 47 Fluid. Literature and sample in polyethylene squeeze flask available on request.
192A *Union Carbide, Silicones Div.

**Caustic Soda**.....A 40-page manual puts at your finger tips the essentials on handling & storing liquid caustic soda, with emphasis on safety & minimum contamination.
67a *Hooker Chemical Corp.

**Coagulant**.....2 p. bulletin CS-105 describes a new complex organic polymeric compound which improves floc formation in all types of clarification systems.
192B Permutit Co.

**Disodium Phosphate**.....Bulletin I-171 is a revised description of the use of disodium phosphate for low-cost boiler water treatment. Methods of external & internal application.
192C Monsanto Chemical Co.

**Elastomer**.....New Fluorel brand is a highly fluorinated synthetic rubber that successfully resists corrosive chemicals, fuels, solvents & ozone. Data.
194 *Minnesota Mining & Mfg. Co.

**Fluorides**.....line includes more than 75 inorganic fluorine compounds. Complete list of fluorides & fluoborates & further data on specific products of interest to you.
59 *General Chem. Div., Allied Chem.

**Fuel Oil Additives**.....“Fuel Oil Additive Manual” describes problems in storage and use of distillate and residual fuel such as sulfur and vanadium corrosion, sludging.
193A L. Sonneborn Sons

**Latexes**.....36 p. booklet describes latexes for conventional coating, nonvulcanized coatings, tips for storage & handling, use with resins, pigments, sequestering agents.
193B Koppers Co.

**MPS-500**.....is a stabilized chlorinated ester of a fatty acid. It finds use, primarily with other plasticizers, in vinyl films, drapery, shoe soles, etc. Data Sheet.
67e *Hooker Chemical Corp.

**Molecular Sieves**.....6 p. booklet describes what molecular sieves are, a typical case history concerning their use in the rubber industry, a survey of suggested uses.
193C Linde Co.

**Molecular Sieves**.....3 p. bulletin CW-1115 describes use of molecular sieves for use as a secondary accelerator with thiazole type primary accelerators.
193D Linde Co.

**Paint Remover**.....1 p. Bulletin 55-7 describes a brush-on, water rinseable paint remover said to be safe & noncorrosive on all common metals. Why & how to use.
193E Turco Products, Inc.

**Peracetic Acid**.....Bulletin No. 60, “Successful Bleaching of Types 670 and 200 Nylon with Peracetic Acid is now available to Chemical Engineering on request.
26-27a *Becco Chemical Division, FMC

**Petroleum Inhibitors**.....8 p. “Eastman Additives for Petroleum Industry,” Bulletin 1-106, tabulates and describes chemical structure, properties & function of antioxid.
193F Eastman Chemical Products

**Phenolic Resin**.....12 p. bulletin describes physical properties and application of firm's asbestos-reinforced thermosetting phenolic resin plastic called Pyrotex.
193G Raybestos-Manhattan Corp.

**Phosphorus Oxychloride**.....A clear, water-white liquid, typically 99.8% pure. Only 0.01% phosphorus trichloride. No free chlorine or phosphorus pentachloride. Data Sheet.
67b *Hooker Chemical Corp.

* From advertisement, this issue

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**Phosphorus Pentachloride**.....Often used in pilot work & other areas where only small quantities are involved. No phosphorus trichloride or nickel. Data Sheet.
**67c** *Hooker Chemical Corp.

**Phosphorus Trichloride**.....A clear and water-white liquid. 99.9% pure. No free phosphorus. Additional information contained in Phosphorus Trichloride Data Sheet.
**67d** *Hooker Chemical Corp.

**Plastics, Laminated**.....16 p. Engineering Data Book contains tables & charts to aid selection of proper laminates and associated products for specific requirements.
**194A** Northern Plastics Corp.

**Platinum Catalysts**.....in the production of high-purity chemicals, pharmaceuticals, vitamins & biotics. Brochure, "The Role of the Platinum Group Metals as Catalysts."
**30-31a** *Engelhard Industries, Inc.

**Polypropylene**.....4 p. preliminary technical data bulletin on new producer's product. Lists physical properties, describes general recommendations for use in injection molding.
**194B** Avisun Corp.

**Protective Coatings**....."Alpex, the Cyclized Rubber in Protective Coatings," describes properties and use. Information was gathered over years of field lab evaluation.
**194C** Alkydol Laboratories

**Silicone, Antifoam**.....for defoaming aqueous systems—SAG 470 Epulsion. Literature and sample in polyethylene squeeze flask available on request.
**194D** Union Carbide, Silicones Div.

**Sodium**.....Brochures, "Handling Metallic Sodium on a Plant Scale," "High Surface Sodium" and "Sodium Dispersions" are now available on request.
**83** *U. S. Industrial Chemicals Co.

## Construction Material

**Alloys**.....Descriptive booklet gives full details on the new material Tantalum. Close to 100% pure, chemically. Produced by the consumable-electrode process.
**163** *Haynes Stellite Co.

**Castings**.....Facilities for furnishing rough or fully machined castings. Feature ductile iron castings. Catalog #401 on castings gives complete information.
**202** *Bethlehem Foundry & Machine Co.

**Coating, Tape**.....offers doubly thick adhesive to seal all voids, lower water vapor transmission rate, higher electrical insulation resistance, etc.
**52** *The Kendall Co.

**Coatings**.....Rokide spray coatings; "A" aluminum oxide, "ZS" zirconium silicate & "Z" zirconium oxide —are hard, adherent, crystalline factory materials. Facts.
**45** *Norton Company

* From advertisement, this issue

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**HAMER PLUG VALVES**

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FLUOREL Elastomer is rated for continuous long-time service at 400°F . . . tolerates 600°F temperatures, and higher, for reduced periods under some service conditions. In addition to good thermal stability, ease of processing, non-combustibility, and excellent resistance to compression set are other outstanding features.

FLUOREL Elastomer greatly extends the performance range of applications requiring elastomeric materials. Its many exciting possibilities make it an important member of the ever-expanding family of 3M organic fluorine compounds. For complete data, write: 3M, Chemical Division, Dept. KAL-89, St. Paul 6, Minn.

**EASE OF PROCESSING** is shown by this disc. Note the reproduction of machine marks from mold surface. FLUOREL Elastomer is sold by the 3M Company as a gum. It can be readily mold processed on standard rubber compounding and fabricating equipment. It may be molded, extruded and bonded to most metals.

**WHEREVER THE HEAT'S ON,** put FLUOREL Elastomer to work for you. It's in use now or under evaluation in the missiles and aircraft, automotive and chemical processing industries for oil seals, "O" rings and gaskets. Other suggested uses: fire walls, air ducts, fuel cells, fuel and hydraulic hose, diaphragms and tank linings.

*The term "Fluorel" is a trademark of Minnesota Mining and Manufacturing Company

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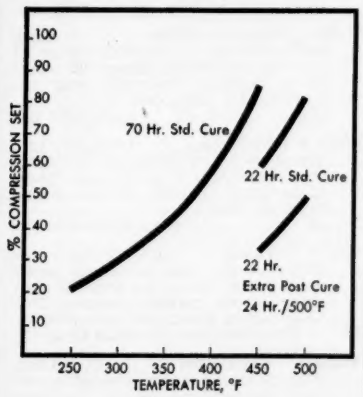
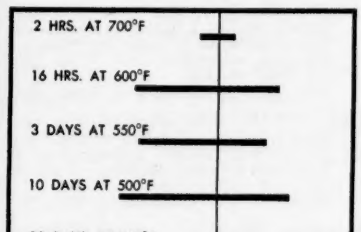
# el*

Charts below illustrate FLUOREL Elastomer resistance to compression set and heat.

COMPRESSION SET (ASTM D-395-52T, Method B)




THERMAL STABILITY (Circulating Air Oven)

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LITERATURE . . .

**Coatings, Corrosion Resistant**.....Bul. No. 259 covers the advantages of Plasite cold set coatings. Also lists all the bulletins that are available on Plasite Coatings.
**195A** Wisconsin Protective Coating Co.

**Construction Materials**.....Brochure describes in general terms the characteristics, corrosion resistance, & the physical properties of coatings.
**195B** Ceramic Coating Co.

**Fabricating**.....facilities include large car bottom-heating & stress-relieving furnaces, heavy plate bending rolls, etc. Booklet describes facilities & services.
**12-13** *Amer. Bridge Div. of U. S. Steel

**Linings**.....Permobond is the rubber lining that is resistant to destructive chemicals. Protects against corrosive attack & can withstand temperatures up to 200 F.
**167** *U. S. Rubber

**Plastic**.....Ryertex-Omicron PVC offers outstanding resistance to 281 corrosive solutions & gases. It is immune to weather, rotting & aging. PVC Bulletin 80-3.
**122** *Joseph T. Ryerson & Son, Inc.

**Resin**.....A wide variety of resin formulations to provide complete protection under almost any condition. Solve your corrosion & contamination problems. Bul. 100.
**168** *Du Verre, Inc.

**Synthetic Rubbers**.....“Elastomers in “Industry” gives information about the properties & many industrial uses of neoprene and Hypalon. The right product for your application.
**147** *E. I. du Pont de Nemours & Co.

**Thermocouple Wire**.....Over 100 variations of insulated thermocouple wire & thermocouple extension wire available. Ask for Buyer's Guide C100-8.
**97** *Minneapolis-Honeywell

**Wire Cloth**.....A 94-page catalog & stock list gives the full range of wire cloth available, describes fabrication facilities & gives useful metallurgical data.
**49** *Cambridge Wire Cloth Co.

**Wire Cloth & Screen**.....resists distortion, corrosion, heat & pressure. Condensed Screen Reference Catalog gives specifications and other details.
**185** *Ludlow-Saylor Wire Cloth Co.

## Electrical & Mechanical

**Adjustable-Speed Drive**.....Adjustable-speed and drive control problems are discussed in Bulletin K-250. Typical applications along with methods of control.
**195C** Cleveland Worm & Gear

**Electric Motors**.....Complete information concerning a new drip proof, splashproof, weather-proof integral horsepower motor line is contained in new brochure.
**195D** Marathon

**Enclosure, Spin Top**.....Bulletin 9990 gives details on enclosures for reversing & non-reversing across-the-line starters and combination starters.
**161** *Square D Company

* From advertisement, this issue


*Just Published*

## RADIATION HYGIENE HANDBOOK

Answers virtually any question on industrial, medical, and research uses of radiation and atomic energy, with special applications to health physics, industrial hygiene, and sanitary engineering. Gives data and methods for measuring radiation and for protecting persons and property from radiation hazards. Describes, classifies all man-made and natural sources of radiation. Discusses waste disposal, air pollution, etc. **Edited by Hanson Blatz, formerly A.E.C. Health and Safety Laboratory. 926 pp., 268 illus., $27.50**

## CHEMICAL ENGINEERING ECONOMICS

**Just Published** — Latest thinking on how to make profitable decisions when evaluating chemical engineering projects. Shows the relation of engineering practice to problems of investment, cost, price, and profit. Discusses economic side of such features of chemical industry as cost accounting, research, process development, manufacturing, and selling . . . all slanted to engineer's point of view. **By C. Tyler and C. H. Winter Jr., E. I. duPont de Nemours & Co. 4th Ed. 187 pp., 40 illus., $7.00**

## ORGANIC CHEMISTRY

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## CHEMICAL ENGINEERING PLANT DESIGN

**Just Published**—Shows development of a chemical process from inception in research laboratory, through pilot plant development, process design, preliminary plant design and economics, and final detailed project engineering for plant design and construction. Also includes new material on nuclear chemical plants, as well as design for conventional processes. **By F. C. Vilbrandt, Virginia Polytechnic Institute, and C. E. Dryden, Ohio State University. 4th Ed. 550 pp., 118 illus., $12.00**

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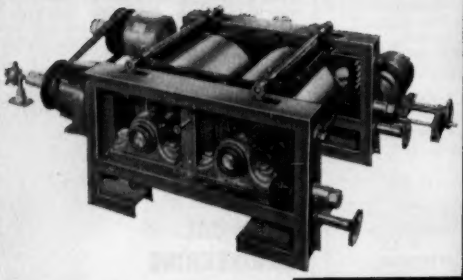

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For rapid and continuous conversion of liquids and slurries to dry solids. G-B atmospheric drum dryers provide an economical and practical means of drying many chemicals.

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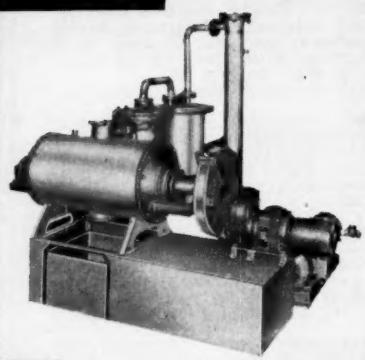
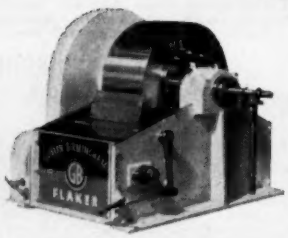
For heat sensitive products and recovery of solvents. G-B vacuum rotary dryers used for removal of moisture from centrifuged or filtered solids at low temperature levels.



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LITERATURE . . .

**Magnetic Brakes**.....Bulletin explains in detail the construction features of EC&M Type WB magnetic brakes, which are available in six sizes to cover 600-series motors.
196A Electric Controller & Mfg.

**Mechanical Seal**.....The Dura Seal provides mechanical sealing for the widest range of pressures, temperatures & speeds. Technical information on request.
169 *Durametallic Corp.

**Motive Power Batteries**.....Manufacturer has updated its bulletin of detailed, step-by-step instructions on motive-power battery installation and maintenance. 20 pages.
196B Exide Industrial Div.

**Motor**.....with a built-in-corrosion protection. Complete design details and other information on corrosion-proof motors is contained in Bul. B-2406.
215 *Reliance Electric & Engr. Co.

**Motor Control Lines**.....Complete information & helpful application data on Safair and Safuse Magnetic Control are available. Publication 242A & 249.
14-15 *E-M Elec. Mach. Mfg. Co.

**Motors, Explosion-Proof**.....in sizes up to 600 hp. In a wide range of mechanical modifications & electrical characteristics for your requirements. Bul. 800.
104 *Louis Allis Co.

**Plugs & Receptacles**.....Complete terminal units, equipped with solderless connectors enable connections to be made quickly with a minimum of effort.
54 *Appleton Electric Co.

**Speed Variator**.....provide both increase & decrease of output speed on a range up to 9:1 from a constant speed power source. Bul. K-250 gives complete control story.
79 *The Cleveland Worm & Gear Co.

**Voltage Regulators**.....Application, description, selection, weights, dimensions and connection diagrams are given in booklet on dry type and filled voltage regulators.
196C General Electric

## Handling & packaging

**Bagging Scale**.....The E-50 gives accuracy within 1 ounce at speeds of ten or more 50-lb. bags per minute. Handles weighing from 5 to 200 lbs. Full details.
200 *Richardson Scale Co.

**Cans**....."F" style cans have a recessed bottom that fits securely on top of can below. Available in 5 convenient sizes ranging from 8 oz. to 1 gallon size.
89 *Continental Can Co.

**Industrial Trucks**.....Brochure gives the pros and cons for both the walkie and rider-type industrial trucks, and how they are used in industry. Applications.
196D Automatic Transportation

**Payloader**.....The H-25 feature maneuverability & speed with 2,500 lb. carry capacity. Facts about the H-25 Payloader and other Payloader models is available.
92 *The Frank G. Hough

**Screw Conveyor Line**.....Quik conveyor screw, hangers, tro ends, countershaft ends, trou drives, etc. are completely covered in Book 2989.
6 *Link Belt

* From advertisement, this issue

**Storage Racks**.....Illustrated reference book entitled "Be Your Own Storage Rack Expert" outlines new concept of rack design and construction using ordinary piping.
**197A** Tube-Strut Corp.

## Heating & Cooling

**Air Cooled Condensers**.....Standard sizes from 7½ to 100 tons based on 120° condensing temp. 40° suction, 100° ambient. Complete facts on request.
**99** *Buffalo Forge Co.

**Blast Heaters**.....Wide range of sizes furnished with or without pressure blowers. Compact cast iron design requires less space. Complete story in Catalog 956.
**65b** *D. J. Murray Mfg. Co.

**Cooling Towers**.....Process Data Sheet 700(1), "L&N pH Control of Cooling Tower Water" & the Controllability Analysis Questionnaire for answers to your Problems.
**91** *Leeds & Northrup Co.

**Electric Process Heaters**.....New 64-page catalog illustrates the complete line of Chromalox electric process heaters, and describes their many uses. Technical section.
**197B** Edwin L. Wiegand

**Heat Exchangers**.....Catalog contains information on application, installation & operation of standard plate, bayonet, & coil type exchangers, plus circulation steam jets.
**151** *National Carbon Co.

**Heat Exchangers**.....New edition of "Design & Cost Comparison of Heat Exchangers Using Wolverine Trufin" includes helpful bare tube to Trufin conversion charts.
**197C** Wolverine Tube

**Heat Transfer**.....Multi-Zone Plate-coil provides for higher pressure containment & a margin of heat transfer capacity. Bul. P61 for complete performance data.
**129** *Tranter Manufacturing Inc.

**Heating Elements**.....New 4-page bulletin SHA describes and diagrams forms of special strip heaters for the 100 to 1,200 F. range. Wattages, sizes, prices, etc.
**197D** Acra Electric Corp.

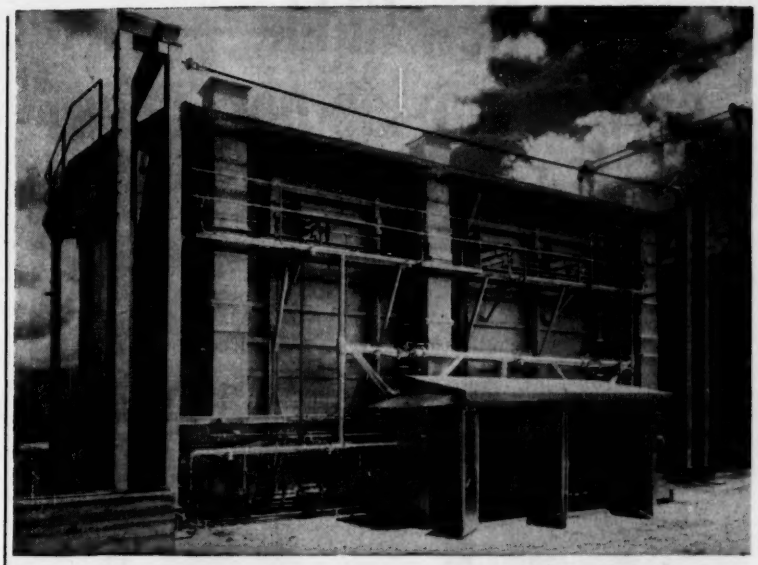
**Heating & Cooling Equipment**..... Brochure on stainless steel equipment such as cooling & heating coils, coil type spray dehumidifiers, coils, spray dehumidifiers, cooling towers & evaporative condensers.
**105** *Marlo Coil

**Insulation**.....Careytemp, a completely new pipe and block insulation for temperatures to 1,600 F. is covered in brochure. Features exceptional water resistance.
**197E** Philip Carey Mfg. Co.

**Plate Heat Exchanger**.....requires but one-fourth the transfer surface of a shell and tube exchanger. Complete information is available on request.
**16-17c** *The De Laval Separator

**Radiators**.....for use in confined areas where motorized units are not desirable. For low or high pressures to 250 PSI. Additional information in Catalog 956.
**65c** *D. J. Murray Mfg. Co.

* From advertisement, this issue

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NEW FACILITIES . . . at Avondale Marine Ways now make it possible to offer a wide range of products and services directly to the chemical and petrochemical industries. In addition to large plate rolls for heavy steel fabrication, there is the specially designed, automatically controlled furnace with temperatures up to 2100°F. shown above.

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# New Kidde carbon dioxide portables awarded highest U.L. rating!

**Belleville, N. J.** — A spokesman for Walter Kidde & Company announced here today that four of the company's new portable fire extinguishers have been awarded the Underwriters' Laboratories highest ratings for their respective capacities. To those interested in fire safety, this means that, pound for pound, these new Kidde units have more fire-killing power than any other carbon dioxide extinguishers on the market today.

Available in 15 and 20 pound capacities, in either squeeze valve or trigger models, these power-packed Kidde units feature new hose and discharge horn assemblies, which are responsible for their extra fire fighting ability. The new assembly is supplied also with Kidde's 10 pound carbon dioxide portable which has a U. L. rating not exceeded by any other extinguisher of its capacity. This hose-horn combination is also being offered as a replacement unit for existing 10, 15 and 20 pound carbon dioxide units, and when attached will upgrade their effectiveness equal to the new ratings.

For more information on these top-rated Kidde carbon dioxide portables write Kidde today.

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**828 Main St., Belleville 9, N. J.**
Walter Kidde & Company of Canada Ltd.
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LITERATURE . . .

**Steam Trap**.....Impulse gets equipment hot fast & keeps it hot. Good for all pressures. Complete line of Steam Traps, all operating on a proven thermodynamic principle.
159 *Yarnall-Waring Co.

**Steam Traps**.....A 48-pg. book tells how to correctly size, install & maintain steam traps for any pressure, temperature or any load. Also Catalog K for data.
48 *Armstrong Machine Works

**Steam Traps**....."Balanced Pressure" Thermostatic steam traps cut trap maintenance costs & simplify parts inventory. This trap can't air-bind. Literature Kit 1A offered.
100 *Sarco Company, Inc.

**Unit Heaters**.....are available in Horizontal & Down Blow models. All cast iron built for steam pressures up to 250 PSI 450 Degrees. Catalog 956.
65a *D. J. Murray Mfg. Co.

## Instruments & Controls

**Analyzer-Recorder**.....Measures & records excess air & the mixing efficiency of your fuel-burning equipment. Details in Product Specifications E65-1 & E12-5.
106 *Bailey Meter Co.

**API Meter-Relays**.....Exclusive design features that provide control reliability of API meter-relays are described and illustrated in a new illustrated bulletin.
198A Assembly Products, Inc.

**Controller**.....New Pilot Controller is a compact, inexpensive unit for positive remote control of temperature or pressure in countless applications. Bul. PC-113.
171 *Fulton Sylphon Div.

**Data-Processing System**.....New 55-page manual describes the large-scale Univac 1105 data-processing system. Among features are high speeds, versatility, capacity.
198B Remington Rand

**Density Instrument**.....Pamphlet describes a Densometer for the continuous measurement of fluid densities during cementing and drilling operations. Records results.
198C Halliburton

**Electronic Computer**.....for automatic computation with no limitation on the complexity of system. Offers full accuracy. Details available on request.
77 *Blaw-Knox Co.

**Electronic Transmitter**.....is suitable for operation in an ambient temperature range between —20 & 150 F; other ranges available on special order. Facts.
87 *Fischer & Porter Co.

**Gas Analyzers**.....You can learn more about the Infrared Analyzer & its recorder by requesting Demonstrator ND46-91(1), "How the L&N infrared Gas Analyzer Works".
37 *Leeds & Northrup Co.

**Gauge, High Pressure**.....has pointer connected directly to pressure element. Available in pressure ranges from 0-1000 to 0-10,000 psi. Complete information.
186 *Rochester Mfg. Co., Inc.

**Meter**.....Auto-Stop . . . the push-button meter that automatically shuts off at the exact quantity. Helpful meter data contained in Bulletin 566 E.
183 *Neptune Meter Co.

* From advertisement, this issue

**Recorders, Recording Controllers**..... New family of continuous self-standardizing strip-chart recorders and recording controllers is the topic of GEA-6887, 12 pages.
199A General Electric

**Resistance Temperature Elements**..... Resistance elements for measurment of temperatures to 1,200 F. under pressures to 4,500 psi. are described, illustrated in E51-6.
199B Bailey Meter Co.

**Solid-Front Gages**.....Catalog describes recently introduced line of solid-front pressure indicating and test gages. Units come in three diameters, 4½, 6, and 8½ in.
199C Crosby Valve & Gage

**Temperature Control**.....Details on pneumatic, electric or self-contained gas control (recording, indicating or non-indicating), to fit your application.
109 *The Partlow Corp.

**Viscometers**.....Synchro-Letric Viscometers & process mounted Viscomertans provide accurate measurement, evaluation & control of viscosity in fluid. Information.
192 *Brookfield Engineering Lab.

## Pipe, Fitting, Valves

**Fittings**.....New Pipe-Mate light-wall stainless steel fittings and flanges for noncritical process piping are described in a 6-page bulletin. Charts give data.
199D Tube Turns

**Hose, Fire**.....D-500 is available with white, black, yellow or red cover for ready visibility as well as for those who require color-coded fire-fighting lines. Details.
61 *Goodyear, Industrial Prod. Div.

**Pipe & Fittings**.....Data on Fluoroflex-T Type S pipe & fittings is available. Corrosion-proof for service to 500 F in chemical & corrosive solutions. Bul. TS-1A.
153 *Resistoflex Corp.

**Pipe**.....High impact rubber-plastic. Most economical for average chemicals. Screw or solvent welded fittings. Valves ½ to 2". Bulletin 80A.
172b *American Hard Rubber Co.

**Pipe**.....All-purpose rigid PVC in schedules 40, 80, & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". Bulletin CE-56, for details.
172c *American Hard Rubber Co.

**Pipe**.....Saran Lined Pipe, fittings, valves & pumps are available for systems operating from vacuum to 300 psi, from below zero to 200 F. Information available.
111 *The Dow Chem. Co.

**Pipe, Fittings, Valves**.....Catalog 356 contains details including charts, diagrams & illustrations on jacketed piping, fittings, plug valves, joints, etc.
200A Parks-Cramer Co.

**Pipe, Plastic**.....Ace-Ite, chemical-resistant rubber-resin blend pipe is the surest way to stem the tide of corrosion. Handles most chemicals. Bulletin CE-80.
173 *American Hard Rubber Co.

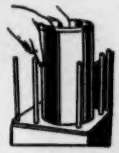
**Pipe, PVC**.....is available in lengths of 10 or 20 ft. & 30 ft. on special orders. It trouble-proofs drain & sewer lines. Comprehensive new PVC Catalog offered.
145 *A. M. Byers Co.

* From advertisement, this issue


# IT'S A FACT:

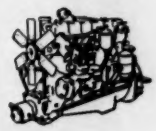
## ALLIS-CHALMERS LIFT TRUCKS SAVE YOU MORE... MAKE YOU MORE!

***HERE'S PROOF...*** When it comes to sustained high production over the years — ability to stay on the job and out of the shop — Allis-Chalmers trucks have it! As these owners happily admit:



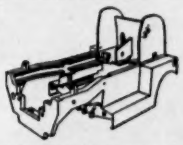
**"They're tougher and require less maintenance,"** says the mechanic at a Wisconsin foundry. "I particularly like the overhead valves and wet cylinder liners — makes our job a lot easier."

**Reason:** Wet cylinder liners are easily replaced — no need to rebore.



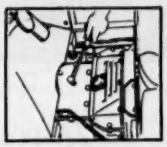
**"Maintenance costs are one-third less** than with lift trucks previously used" reports a Michigan factory. "We used to replace an engine a year," says the vice-president. Haven't replaced any in our Allis-Chalmers trucks."

**Reason:** The heavy-duty, industrial engine is the strongest and most rugged used in a fork truck.



**Downtime, None** — That's the report of a Florida cement block manufacturer. His 4,000-lb lift truck has operated steadily for more than three years.

**Reason:** Rugged construction of Allis-Chalmers trucks which is typified by automotive-type frames.



**"They're certainly accessible to work on,"** says the mechanic at a Missouri factory, "— although we have not had too much maintenance and no parts replaced at all so far."

**Reason:** A good example of accessibility: only 30 minutes is required to change a clutch.

Let your material handling dealer show you additional production and maintenance figures for Allis-Chalmers lift trucks that make their superiority a *fact*. Allis-Chalmers, Milwaukee 1, Wisconsin.

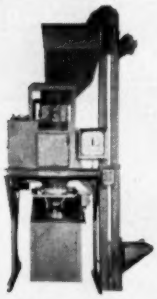
AC ALLIS-CHALMERS

Plan to stay ahead... MODERNIZE!

BH-105C

*If you overweigh you lose money...*
*If you underweigh you lose customers!*

*Richardson Automatic Bagging Scales are the answer to this problem.* They provide high speed bagging with accuracy that eliminates give-away of product, avoids customer complaints of shortweights. Higher production speeds mean reduction in costs, too.



*The Richardson E-50 Bagging Scale* gives you all these benefits –

**Accuracy** – within 1 ounce at speeds of ten or more 50-lb. bags per minute!

**Versatility** – handles weighings from 5 to 200 lbs. of grains, plastics, powdered and granular chemicals, feeds and meals, pellets, sugar, salt, and many others.

**Dependability**–ruggedly-built for years of trouble-free service.

For full details on the Richardson E-50 and other bagging scales write today.

Richardson Scales conform to U.S. Weights and Measures H-44 for your protection.

*Here's the answer...*

**Richardson**
MATERIALS HANDLING BY WEIGHT SINCE 1902

1790

**RICHARDSON SCALE COMPANY • CLIFTON, NEW JERSEY**

Sales and Service Branches in Principal Cities • Also manufactured in Europe to U.S. standards

LITERATURE . . .

**Pipe, PVC**.....is lightweight, resists acids, corrosion, aging, weather & abrasion. Details on the many advantages of Koroseal PVC pipe are available.
1 *B. F. Goodrich

**Plug Valve Lubricants**.....Reference Book 39-Section 1A contains suggested valve uses & recommended lubricants. Also describes lubrication accessories.
200B Homestead Valve Mfg. Co.

**Tubing**.....Brochure covers welded carbon and stainless steel tubing. Composition, advantages, quality test results, sizes offered, special shapes and typical applications.
200C Formed Steel Tube Institute

**Tubing**.....The new data book and catalog give complete details on Penflex tubing. Available in steel, bronze & stainless steel from ⅛" I.D. to 24" I.D.
206 *Pennsylvania Flexible Tubing

**Tubing**.....a complete line of integrally-finned tubing. Services of Technical Representatives are available to the heat transfer industry at large.
93-96 *Wolverine Tube Div.

**Valve**.....Flo Ball 715 is ideal for leakproof control of air, vacuum, steam, water, fuels, etc. Catalog describes this valve & others for corrosive & cryogenic media.
69 *Hydromatics, Inc.

**Valve, Ball**.....Illustrated booklet contains a general summary of design features & advantages, industrial applications, maintenance, material, and sizes.
200D Jamesbury Corp.

**Valve, Ball**.....Four models available in sizes ¾" through 2". Full details on the new Type 316 Double Seated Stainless Steel Ball Valve are offered.
22-23 *Rockwood Sprinkler Co.

**Valves**.....Line Blind feature absolute line shut-off. Removes fire hazard of sparking & stops damage to equipment. Plug valves are perfect for hard-to-hold fluids.
193 *Hamer Valves

**Valve, Control**.....with quick-reversible valve control are perfect for pilot plant operation & other processes. Type & materials to meet any process requirement. Bul.
85 *The Foxboro Co.

**Valves**.....Wide selection of valves & features plus such accessories as pneumatic & electric valve positioners for hysteresis-free control & a complete line of controllers.
98 *Republic Flow Meters Co.

**Valves, Butterfly**.....for gas, vapor, liquid or semi-solid control problems. Simplicity of design makes them easy to service & maintain. Literature.
T205 *Fisher Governor Co.

**Valves Butterfly**.....Tables showing allowable pressure drop for seven classes of metal-seated wafer butterfly valves are among detailed information in Bulletin 583.
201A W. S. Rockwell Co.

**Valves, Check**.....available in ¼" thru 2" sizes in both screw & socket weld ends. Forged steel bodies are designed for light weight with maximum strength.
141 *Henry Vogt Machine Co.

* From advertisement, this issue

**Valves Coated**.....Illustrated bulletin describes manufacturer's special coated lubricated plug valves. Tables of recommended applications. Available on request.
**201B** Rockwell Mfg. Co.

**Valves, Corrosion-Resistant**.....for all your flow control requirements; water, oil, gas, air, steam, as well as corrosive fluids. Information on request.
**10-11** *The Wm. Powell Co.

**Valves, Diaphragm**.....available for a wide variety of services . . . from water, air & gas to corrosive, volatile & hard-to-hold liquids. Bulletin AD-1942.
**119** *Crane Co.

**Valves, Diaphragm**.....Helpful guide discusses primary considerations in selecting valves, shows engineering principles & benefits of diaphragm valve & applications.
**101** *Hills-McCanna Co.

**Valves, Drain**.....The Ram type drain valves cannot clog up whether in open or closed position. A catalogue containing complete information is offered.
**178** *Strahman Valves, Inc.

**Valves, Gate**.....In a wide range of corrosive & errosive services these valves withstand corrosion. Information folder No. 205 gives details on Ni-Resist valves.
**121** *Jenkins Bros.

**Valves, Plastic-Coated**.....The plastic coating of these valves offers complete corrosion resistance. Replacement costs eliminated. Information available.
**44** *DeZurik Corporation

**Valves, Plug**.....Jacketed plug valves can be supplied for air or hydraulic operation. Complete description, details and dimensions in new catalog supplement 356-S.
**184** Park Crane Co.

**Valves, Safety-Relief**.....offers simplicity in design, safety in operation. Detailed information for selection & sizing of safety-relief valves in Catalog FE-118.
**174** *Farris Engineering Corp.

## Process Equipment

**Attrition Mills**.....Data sheet gives information and specifications on attrition mills. Two basic types covered are double-disk and single-disk attrition mills.
**201C** Munson Mill Machinery

**Centrifugal**.....Solid Bowl deliquors solids as coarse as half inch, or as fine as a fraction of a micron, & everything in between. It is readily made fume or vapor tight.
**2** *Bird Machine Co.

**Centrifugal**.....Available in a wide range of sizes—to handle a wider-than-usual range of capacities & pressures. Feature heavy-duty ball bearings. Bulletin.
**102** *Gardner-Denver Co.

* From advertisement, this issue


**an adams report**

NO. 3 OF A SERIES

# WATER IS VITAL
## to your job and future!

The demand for industrial water will all but double in the next 18 years. With 40% of our communities now facing water shortage problems, approximately two of every five persons will be directly affected at work.

**Magazine Editors Voice Concern...**

**Chemical Engineering** featured the water shortage problem in their December 1957 issue; **Plant Engineering** ran a feature on water conservation in February 1958; **Chemical & Engineering News** in their March 24, 1958, issue headlined a feature story, *Needed: An Extra 250 Billion Gallons of Water a Day by 1975.*

In May, 1958, **Water Works Engineering** had a story entitled, *There Is Enough Water — if We Conserve It!* It was followed by another article, *For Lack of Enough Water, Industries Can Be Lost.* **Chemical Engineering Progress** in January 1958, covered one phase of conservation in their *Water Reservoir Evaporation Control.*

In its September 29, 1958 issue, **Steel** asked, *Water, Water Everywhere?* and came up with the answer, "No!" It forecasts the expense of industrial water will more than double by 1975.

***...Municipal Water Rates Going Up***

**American City** in its January, 1959 issue started a survey of *Modern Water Rates.* Here are a few of the rates charged per 1000 gallons for large volume users: Ames, Iowa — 42¢; Blytheville, Ark. — 13¢; Brunswick, Ga. — 11½¢; Buhl, Idaho — 6¢; Dowagiac, Mich. — 9½¢; Hemet, Calif. — 12¢; Houlton, Maine — 10½¢; Jackson, Tenn. — 12¢; Laconia, N. H. — 13¢; North Andover, Mass. — 17¢.

The above rates are based on the minimum charge made for water and do not include any of the extras that may apply in the city cited. For example, some areas charge extra for customer-owned fire hydrants, fire lines, and sprinkler heads. Thus, a normal plant in these areas will actually pay more for their water than the minimum rate shown above. Also, all rates are on a sliding scale, so the average rate will be slightly higher than that indicated.

***Industry Must Face the Facts...***

By 1975, the chances are good that more than 20% of capital investment in a plant will be spent on water. Included in this estimate are: source development, delivery, treatment, piping and waste disposal. Already the mythical rate of 10¢ per 1000 gallons, which Industry considers a maximum charge, is a thing of the past.

**...Recirculation Offers Many Advantages**

Possibly the most promising way of keeping your water costs down is through recirculation. Many plants have turned to this method for numerous reasons:

a. Total water used sharply reduced.

b. Waste must be cleaned up before discharging, so there's little additional treatment required for re-use.

c. Heat formerly lost is reclaimed.

d. Less lost-production time due to water failure.

e. Makes for good community and area relations.

f. Provides a ready supply of water for fire service under emergency conditions.

g. Reclaimed waste can often be developed into a valuable by-product.

h. Maintenance of water cooled heat exchangers sharply reduced.

Filters are becoming more and more important as components of a modern plant's water system. If you feel you would like to discuss or study your own plant's water problem with a member of the R. P. Adams Company, Inc., organization, write us today, at 207 E. Park Drive, Buffalo 17, N. Y.

**CONSERVE WATER, OUR MOST VALUABLE NATURAL RESOURCE**

**R. P. ADAMS COMPANY, INC.**
**207 E. PARK DRIVE**
**BUFFALO 17, NEW YORK**

AU-59

We have a problem involving liquid filtration. Ask your local representative to call on us.

Name_____ Title_____

Company_____

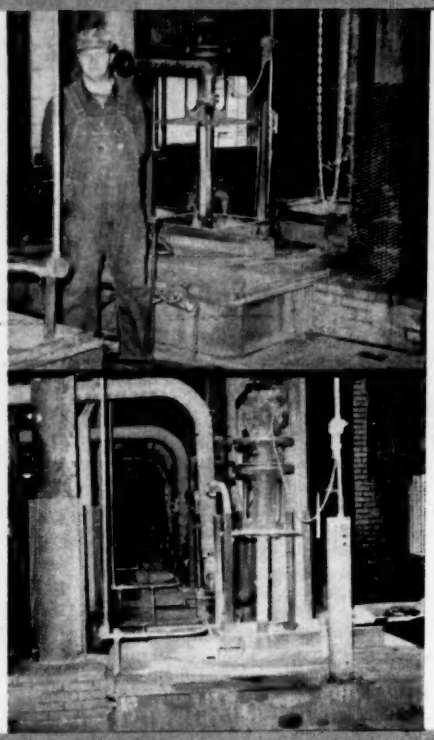
Street_____

City_____ State_____

# BETHLEHEM'S 50 Years of Experience

ASSURES

LOWER FIRST COST, LONG LIFE FROM METALLURGICAL SOUND CASTINGS



FOR YOUR

*Bethlehem Caustic Pots at Koppers Co. Plant*

## CHEMICAL PROCESS CASTINGS

Bethlehem castings are the outgrowth of a half century of experience in metallurgy, design, and foundry practice in manufacturing items used in highly corrosive and at high temperature and pressure.

The above photo shows one of our pots in service producing caustic under high temperature and corrosive (alkaline) conditions. Our pots are used in production of sodium bisulphate, dyestuff intermediates, sulphonation for example.

Our engineers will be glad to make recommendations for your specific needs. Write now for Bulletin 401 on castings.

**BETHLEHEM**

**FOUNDRY & MACHINE CO.**

**4 Plaza Square, Bethlehem, Pa.**


LITERATURE . . .

**Centrifugal**.....Low product moisture, high capacity & economical operation are functions of the Reineveld Centrifugal. Complete information in Bulletin 356.
T203 *Heyl & Patterson, Inc.

**Centrifugals**.....for liquid-solids separation. Literature on Batch-O-Matic, Batch-Master, Suspended, Center-Slung, Maxi-Flex and Continuous is now available.
8-9a *American Mach. & Metals,

**Collectors**.....The perfect collector for spray dryer, rotary dryer or flash dryer processes. Bulletin on the new D-584 Dust Collector is offered.
B203 *Dustex Corp.

**Drum Dryers**.....for rapid & continuous conversion of liquids & slurries to dry solids. Atmospheric drum dryers provide practical means of drying many chemicals.
196a *Goslin-Birmingham Mfg. Co.

**Dryer Air**.....operates on any 110 volt a.c. line. Unit supplies up to 20 cubic feet per minute of air, dried to a dewpoint of 60 F. or lower. Bulletin B6A.
179 *Pittsburgh Lectrodryer

**Dryers**.....New line of mechanical drive dryers can be used for either drying or cooling & are available in direct or indirect types. Information.
103 *The Jeffrey Mfg. Co.

**Dryers**.....Dryers, kilns, coolers and other heavy rotary processing equipment are described in a new 28-page technical bulletin. Graphs for calculation simplification.
202A Standard Steel Corp.

**Dryers, Vacuum Tumble**.....offer pre-tested, pre-packaged savings. Technical literature on these dryers and details of facilities for pre-tenting.
24-25 *Patterson-Kelly Co., Inc.

**Flakers**.....for rapid & continuous conversion of molten products to solid flakes. Fully enclosed or open types may be used to produce many products in a flake form.
196c *Goslin-Birmingham Mfg. Co.

**Filter Media**.....Feon is available by the roll or tailored to fit all types of fluid/solid separation process equipment. Literature is available on request.
8-9d *American Machine & Metals, Inc.

**Filters**.....Full-range type & size availability assures you of maximum suitability of equipment. Designed for automatic or semi-automatic operation. Bul. F-2049.
Cover *The Elmco Corp.

**Filters**.....Vertcial leaf models in both horizontal & vertical tank designs, Batch-Miser in horizontal plate models for polish filtration & batch operations. Lit.
8-9c American Mach. & Metals, Inc.

**Filters, Continuous**.....Literature on pressure type continuous filters with vacuum or pressure rotary drum and horizontal table is now available.
8-8b *American Mach. & Metals, Inc.

* From advertisement, this issue

**Fog Coalescer**.....Fog coalescer for use where air compressors are applied is topic of new bulletin. Engineering and pricing information. Unit used with mist eliminator.
**203A** Metal Textile Corp.

**Kilns & Slakers**.....feature advanced design for operating economy. In daily use by the processing industries. Additional information in Bulletin No. 1115.
**32** *Traylor Engineering & Mfg. Co.

**Metal Screens**.....How to specify perforated metal screens is described in a new brochure. Covers Cross Hexcreen, Conidure pierced sheets and Rima wedge-wire screens.
**203B** National-Standard Co.

**Micronizers**.....grind & classify in one operation in a single chamber. Classifying is simultaneous & eight models are available. Full description in Bul. No. 091.
**182** *Sturtevant Mill Co.

**Mills Grinding**.....for your specific needs. Rod, Ball, Pebble, Tube, & Compartment types, in sizes from 6 to 13 ft. in diameter & up to 50 ft. in length. Details.
**20-21** *Nordberg Mfg. Co.

**Mills, Hammer**.....feature extra heavy manganese steel liners & breaker plates, oversize shafts, massive parts & reinforcements. Catalog is available.
**43** *Williams Patent Crusher

**Mills, Impact**.....Bulletin tells most efficient method of achieving particle size reduction by centrifugal force. Available in all sizes for any requirement.
**203C** Safety Industries, Entoleter Div.

**Mill, Super Roller**.....offers many advantages such as flexibility of layout and dust free operation. Further details are contained in Catalog #79.
**120** *Combustion Engineering, Inc.

**Mixers, Centrifugal**.....New principle of high speed mixing producing intimate dispersion is covered in bulletin. Compact unit adaptable to continuous or batch system.
**203D** Safety Industries, Entoleter Div.

**Pilot Plant**.....provides a complete centrifugal processing facility in which you can test your processes. Stages for mixing, reaction, heating, etc. Details.
**16-17a** *The De Laval Separator Co.

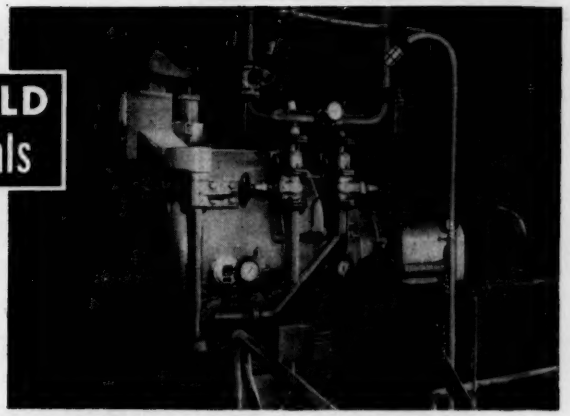
**Rotary Steam Tube Dryer**.....Catalog A contains information on this type dryer. Equipment available for pressing, drying & cooling problems.
**B204** *Davenport Machine & Foundry

**Rupture Discs**.....Corrosion-resistant rupture discs for dependable instand & automatic relief of excess pressure. Additional information in bulletin.
**30-31b** *Engelhard Industries, Inc.

**Screen Separators**.....Bulletin covers the manufacturer's vibrating screen separators and special applications in the feed processing industry. Cross-sectional drawing.
**203E** Southwestern Engineering

* From advertisement, this issue


REINEVELD centrifugals



MORE CYCLES... more pounds per cycle...

One labor-saving Reineveld 51" Automatic Centrifuge replaces three manually operated machines . . . **also** gives lower moisture, more uniform product and higher purity due to automation and inherently higher "G's" of the Reineveld design.

At Cyanamid of Canada, Ltd., . . . on a difficult dewatering application . . . the above 51" Reineveld reduces moisture from 70% to as low as 7%, producing as high as 60 tons of dried solids per day.

*Consult our listing in CEC or write for bulletin 356.*

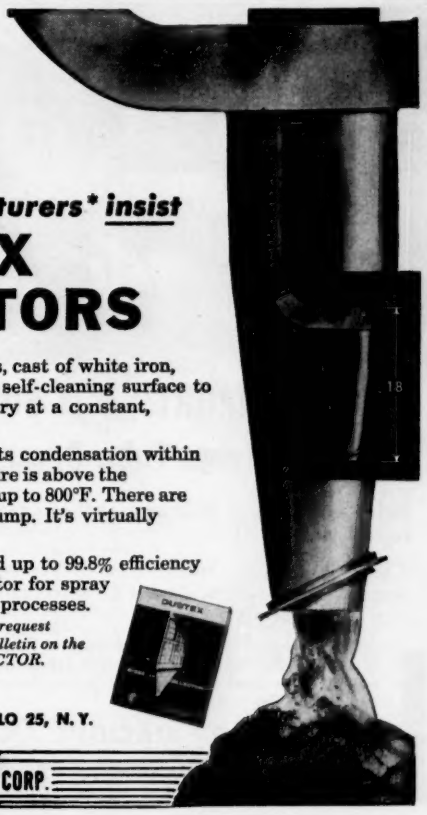
**Sold and Serviced by:**

**HEYL & PATTERSON, inc.**

55 FORT PITT BLVD., PITTSBURGH 22, PA.

H&P

where there's a **drying operation** leading manufacturers* insist on **DUSTEX COLLECTORS**



DUSTEX miniature cyclone tubes, cast of white iron, provide an ultra-hard, cling-free, self-cleaning surface to assure maximum material recovery at a constant, high-speed rate.

DUSTEX patented design prevents condensation within the collector when inlet temperature is above the dew point. Handles temperatures up to 800°F. There are no filters to clog, no sludge to pump. It's virtually maintenance free!

LOW INSTALLATION COST and up to 99.8% efficiency make DUSTEX the perfect collector for spray dryer, rotary dryer or flash dryer processes.

*Name on request

*Write today for this free bulletin on the new D-584 DUST COLLECTOR.*




P.O. BOX 2520, BUFFALO 25, N. Y.

Dustex CORP.

## LOW COST PUMP
### for Laboratory Use

- Pumps Liquids, Gases, Slurries
- No stuffing boxes
- No shaft seals
- No check valves
- Non contaminating

### The New "Kinetic Clamp" Pump

Operates by the action of radial arms successively pressing on a loop of flexible tubing. The mechanism clamps one arm against the tubing while the next arm descends to clamping position. Previous clamping arm then raises to permit tubing to assume its normal shape and again fill with liquid being moved.

Standard laboratory tubing can be used. There is no danger of corrosion or contamination.

Pumps can be furnished with motor or for driving from laboratory stirring motor. Write for literature and prices.

**SIGMAMOTOR, INC.**

17 North Main Street • Middleport, N. Y.



author

TALITARIAN. —n. One who
tar'i-an-ism (ô-thôr'i-târ'i-ăn
au·thor'i·ta'tive (ô-thôr'i-tā'tĭ
from, authority; entitled to ob
thoritative teachings. 2. Ha
peremptory. —au·thor'i·ta'tiv
au·thor'i·ty (ô-thôr'i-tĭ), n.; p
auctoritas] 1. Legal or rich
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particular field; as, the Port A
and; —
in support of opinic
ony; witness. b A prec
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like. —Syn.
ôr'i-zā'shŭn (ô'thĕr-i-zā'shŭ
au'thor·ize (ô'thĕr-īz), v.t. 1
commission; as, authc
act.
sanction; as, customs
und for. —au'th
a'thor·ized (ô'thĕr-īzd), adj. 2
hority. b Sanctioned or appro

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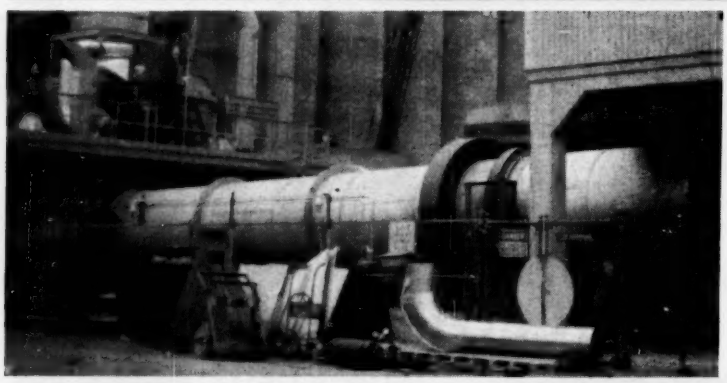

## A "DAVENPORT" 6' x 60' Rotary Steam Tube Dryer

Being erected at a Mid-west Soybean plant to dry soybean flake.

This "Davenport" Steam Tube Dryer is to operate in conjunction with a "Davenport" 8' x 50' Rotary Air Cooler.

Let our engineers consult with you on your Pressing, Drying and Cooling problems or send for our catalog A. For quick reference consult your Chemical Engineering Catalog.

**DAVENPORT MACHINE AND Foundry Company**

DAVENPORT IOWA, U. S. A.

DAVENPORT

PRESSING – DRYING and COOLING Equipment

Continuous DeWatering Presses

ROTARY DRYERS Steam Tube, Hot Air and Direct Fire

Atmospheric DRUM DRYERS

ROTARY COOLERS Water and Air


## LITERATURE . . .

**Screens, Vibrating**.....Important new design, compact, high capacities, low power requirements for long life. Available in all sizes to meet requirements. Bulletin.
**204A** Safety Industries, Entoleter Div.

**Spraying Systems**.....Reference data on adjustable joints for many types of spray nozzle installations are compiled in Bulletin 97. For ¼ to 2½-in. connections.
**204B** Spraying Systems Co.

**Stills & Demineralizers**.....in capacities of from ½ to 2500 gallons per hour. Catalog G on Water Stills & Catalog 127-A on Water Demineralizers available.
**118** *Barnstead Still & Sterilizer

**Tall Oil Process**.....Two AC-VO Nozzle-Matic centrifuges continuously separate tall oil & concentrated salt cake liquor. Details on this process are available.
**16-17b** De Laval Separator Co.

**Vacuum Rotary Dryers**.....for heat sensitive products & recovery of solvents. Used for removal of moisture from centrifuge or filtered solids at low temp. levels.
**196b** *Goslin-Birmingham Mfg. Co.

**Waste Treatment**....."Water, Sewage and Industrial Waste Treatment Equipment" presents manufacturer's complete sanitary engineering equipment line.
**204C** Link-Belt Co.

**Water Treatment**.....Equipment discussed in Bulletin SM-1013 includes the Reactor-Clarifier, flash mixers, flocculation mechanisms, gravity filters, feeders, etc.
**204D** Process Engineers, Inc.

## Pumps, fans, compressors

**Air Cleaner**.....Aridifier prevents contaminated air coming from compressors. Illustrated catalog gives information on models for air lines of ¾ to 10 in. dia.
**204E** Logan Engineering Co.

**Air-Conditioning Systems**.....Kathabar systems offer sterile air and frost-free cooling as special advantages to specifying engineers. Facts available.
**181** *Surface Combustion Corp.

**Air-Cooled Compressors**.....Bulletin fully describes and illustrates Unitair compressors. Included are specifications on eight sizes in the 81 to 641 cfm. range.
**204F** Joy Mfg. Co.

**Compressors, Centrifugal**.....design is capable of sealing against pressures of more than 1000 psi, for utmost dependability in processing service. Information.
**40-41** *Cooper Bessemer

**Compressors, Oil-Free**.....for instrument air and process air. Also a line of centrifugal & axial compressors for oil-free service up to 15,000 horsepower. Bul. 330-11.
**7** *Joy Mfg. Co.

**Industrial Compressors**.....Bulletin No. 651-C covers heavy-duty, four-cylinder industrial compressors for refrigeration service. Tables and installation illustrations.
**204G** Frick Co.

* From advertisement, this issue

LITERATURE . . .

**Pressure Blowers**.....Catalog 1345 describes Airfoil pressure blowers and provides complete selection data including details on inlet air spin control for capacity regulation.
**205A** Westinghouse

**Pump**.....Offers pumping efficiency with faultless corrosion resistance. Hard rubber casing & impeller. Bul. CE-55 gives the complete details.
**172a** *American Hard Rubber Co.

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**42b** *Goulds Pumps, Inc.

**Pump**.....with capacities from 50 to 100,000 GPM. With heads up to 2,500 ft. Complete information on turbine type service pumps in Bulletin No. 300.
**143a** *Layne & Bowler, Inc.

**Pump**.....The new "Kinetic Clamp" pump operates by the action of radial arms successively pressing on a loop of flexible tubing. Literature & prices offered.
**T204** *Sigamotor, Inc.

**Pumps, Centrifugal**.....Advantages of an extensive line of centerline-mounted, Type SVE, single-stage centrifugal process pumps are fully described in Bulletin 135.
**205B** Pacific Pumps, Inc.

**Pump, Centripetal**.....Fig. 2520 handles liquid, air, or liquid & air. Also as a scavenger, for transfer work, for cleaning up, & for pilot plant work. Bul. 725.6.
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**Pump, Chemical**.....Bulletin 440 contains typical applications, flow charts, descriptions & specifications of Pulsafeeder models of various capacities & construction.
**149** *Lapp Insulator Co., Inc.

**Pumps**.....Newly designed models are available to handle a wide variety of corrosive & viscous materials. Full information on new controlled capacity pumps is offered. No. 100.
**180** *American Meter Co., Pump Div.

**Pumps**.....Horizontal Triplex pumps handle large volume of all types & densities of fluid. Capacities from 50 to 6500 GPH . . . pressures from 500 to 12,000 psi. Bul. P-55.
**75** *Manton Gaulin Mfg. Co.

**Pumps**.....Four new 4-page brochures and two 2-page folders describe the complete line of internal-gear rotary pumps offered by the manufacturer. Specifications.
**205C** Wayne Pump Co.

**Pumps, Agitating-Circulating**.....Type PLS for capacities up to 9000 gpm. and type PC for capacities up to 16,000 gpm are covered in Bul. 254. Includes diagrams & illustrations.
**205D** Warren Pumps, Inc.

**Pumps, Short Coupled**.....offer low submergence requirements, simple alignments, etc. Details on propeller & mixed flow pumps in Bulletin No. 350.
**143b** *Layne & Bowler, Inc.

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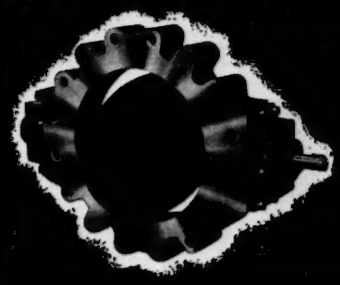

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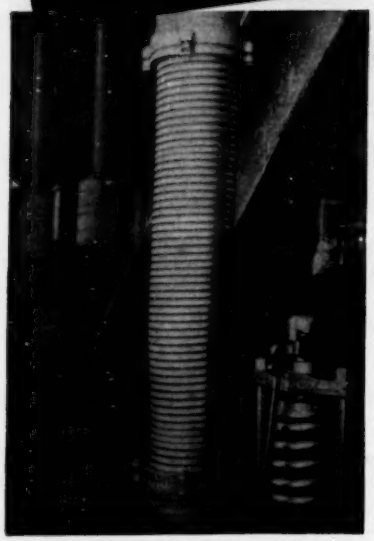

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176 *Kennedy Van Saun

## Services & miscellaneous

**Dryer Steep Bleaching Process**..... Information about this process for insuring brightness permanence by spraying Hydrogen Peroxide across pulp sheet ahead of dryers.
26-27c *Becco Chemical Division, FMC

**Epoxidation Processes**.....Bulletin No. 69, "Epoxidation & Hydroxylation with Becco Hydrogen Peroxide and Peracetic Acid is now available on request.
26-27b *Becco Chemical Division, FMC

**Fabrication**.....Brochure "Heavy Steel Fabrication" is available on request. Outlines a wide range of products & services for the chemical & petrochemical industries.
197 *Avondale Marine Ways, Inc.

**Fire Extinguishers**.....New carbon dioxide portables available in 15 & 20 lb. capacities, in either squeeze valve or trigger models. Information on request.
198 *Walter Kidde & Co., Inc.

**Fire Extinguishing System**.....C-O-Two Systems specially designed for closed or partially closed spaces in which flammable liquids or solids are mfg. handled or stored.
113 *The Fyr-Fyter Company

**Gas Generator**.....is automatic except for startup, with no need for operating personnel. Unit performs in the range of from 25% to 100% of rated capacity. Catalog material.
30-31c *Englehard Industries, Inc.

**Inhalation Therapy**.....A discussion of equipment and techniques for use during the interruption of a worker's breathing is the topic of a book on oxygen therapy.
206A National Cylinder Gas

**Nitration Processes**.....Information on nitration and other chemical processes owned and developed by J. Meissner, Germany is contained in a nine-page bulletin.
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**Sea Water Distilling Plants**.....Bulletin 724 gives engineering information and advantages of the manufacturer's flash-type, land-based sea-water distilling plants.
206D Griscom-Russel Co.

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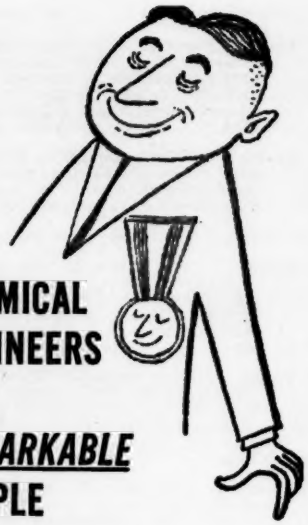

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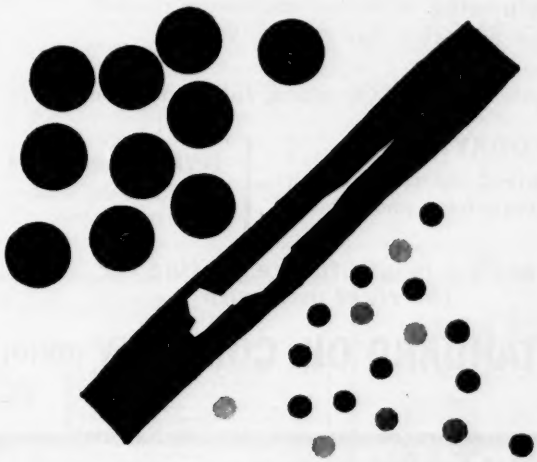

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1—Baker Perkins 200 gal. we cired dbl Sigma blades, jacketed, also internal pressure, Unidor type, size 17, DAM, very hvy duty.
3—Baker Perkins, size 17 200 gal we mixers, 30 hp mtrs., power screw tilt.
1—Baker Perkins 7 gal we, 30 hp mtr mixer, power screw tilt.
2—J. H. Day Series 80, 40" x 120" Robali Gyrating Screens w/mtrs.
1—Stokes model R tablet press.

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| 676 CFM | 100 PSI 15-9¼x12 Worth. & IR |
| 686 CFM | 100 PSI 14x13 Ing. ES |
| 823 CFM | Vac. 18x7 Ing. ES-1 |
| 1545 CFM | 110 PSI 21/13x14 IR XRE |
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| 7950 CFM | 200 PSI 33-17¾x27 Ing. PRE24C |

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MILLS—Hammer—00 Sturtevant 10 HP, AKB Wms. 25 HP, 3W Mikro 30 HP, #2 Gruendler Supermaster 40 HP, #50 Raymond S/S Imp. AKBX Wms. 50 HP, 30 NF Wms. 100 HP, 36 x 52 Jeffrey 125 HP, SXT 14 Penna 350 HP
MILLS—Colloid—1½" US 7½ HP, 2" B&S 20 HP, PA Robinson 5 HP, Sprout Waldron 2—40 HP motors
MILLS—Hardinge—Conical—4½ x 16 (10 HP) pebble, 4½ x 24 (25 HP) ball, 6' x 36" (60 HP) ball, 7' x 22" (75 HP) pebble, 8' x 36" (125 HP) ball, 8' x 48" (175 HP ball, 10' x 48" (350 HP) ball
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S. S. Reactor 1200 gal 200 lb pressure
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### CENT.—FILTERS—EVAPS.—CRYSTAL

1—Bird 32" x 50" Cont. Cent. 316 S.S.
4—Sharples C20 Super-D-Hydrators, 316 S.S.
1—Sharples PN14 Super-D-Canters, 316 S.S.
1—AT&M 26" sus. Cent., perf. bskt., 316 S.S.
1—Oliver 8' x 8' Precoat rubber covered Rotary Vacuum Filter.
12—Sperry 36" plate & frame Filters, rubber covered, cast iron, and wood.
5—8' dia. x 24' rubber lined Crystallizers.

### PULVERIZERS AND MILLS

2—Abbe 5' x 16' brick lined Mills.
2—30' dia. Stainless Steel Micronizers complete with Hoppers, Conveyors, etc.

### KILNS AND DRYERS

1—Traylor 11' x 155' Rotary Kiln, 7/8" shell.
1—Renn. 6' x 60' Rotary Kiln, 5/8" shell.
1—Proctor & Schwartz 8' wide x 60' long Conveyor Dryer, Stainless steel Belt.

### RUBBER LINED TANKS

4—3400 gal. with Turbo Agitators.
5—8500 gal. Vertical Storage 8'6" x 16' x 8' cone
1—13,000 gal. Horizontal Storage 8' x 35'.

### STEEL TANKS

6—2000 to 5200 gal. with Turbo Agitators.
15—Storage Tanks: 3800; 6000; 9000; 10,000; 15,000; 47,000 gals.

### MISCELLANEOUS

7—Dorr Thickeners: 16' dia. with Tanks.
1—Bemis 50# Bag Packer with Sewing Machine, Conveyor and Flattener.
65—LaBour, Durco, Worthite, Duriron and Stainless Steel Centrifugal Pumps 2" to 6" with motors.

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## REACTORS—EVAPS—CONDS—TANKS

6—Struthers Wells 2000 gal. 316 S.S. jktd. agtd. Reactors.
1—500 gal. Walters, 304 S.S. jktd. agtd. Reactor.
1—550 sq. ft. Buflovak, monel, single effect Evaporator.
1—250 sq. ft. Buflovak, 304 S.S. forced circulation Evaporator.
1—7500 gal. 316 S.S. Vert. Storage Tank, 7' x 25' 50 PSI.
1—750 gal. nickel clad Mixing Tank, 125# nickel coils.
1—4000 gal. Haveg Vert. Tank, 8' x 12'.
18,000 gal. 316 S.S. Storage Tank 11' x 24', 3/8" Shell, 5/8" Heads, with 2—320 sq. ft. Heating Coils.
1—12,000 gal. horiz. steel Pressure Tank, 7'6" x 36', 200 PSI.
8—Stainless Heat Exchangers, 1220, 942, 786, 536, 396, 315, 250, 157 sq. ft.

## CENTRIFUGALS

1—Bird 18" x 28" 316 S.S. Solid Bowl, Continuous.
1—Bird 18" x 28", steel, Solid Bowl, NEW, Continuous.
1—Bird 36" x 50", 347 S.S. Solid Bowl Continuous Centrifuge.
2—Sharples PY14, PN14, Super-S-Canters, 316 S.S.
1—Sharples H2 Nozzlejector, 15 HP, 304 S.S.
1—Bird 40" suspended, 347 S.S. perforated basket.
2—Sharples #16, 304 S.S., 3 HP motor.

## FILTERS

1—Oliver 5'3" x 8' Steel Rotary Vacuum, vaporite housing.
1—Sparkler 332S28 Filter, 150 sq. ft. 304 S.S.
1—Niagara 36H110 horizontal Filter, 110 sq. ft., 304 S.S.
1—Sparkler 33-S-17 Steel Filter, 92 sq. ft.
1—#12 Sweetland Filter, 48 leaves, 3" centers, 640 sq. ft.
2—#10 Sweetland Filters, 27 leaves, 4" centers, 250 sq. ft.

## DRYERS

1—Devine Vacuum Shelf with 19—59" x 78" shelves.
1—Devine Vacuum Shelf with 10—40" x 43" shelves.
2—Devine 5' x 12', 4' x 9', Atmospheric, Single Drum.
1—Baker Perkins 5'6" x 6' Rotary Vacuum Dryer.
1—Buflovak 3' x 20' Rotary Vacuum Dryer, 316 S.S. Unused.
2—Louisville Rotary Steam Tube 6' x 25', 6' x 50'.
4—Rotary Dryers, 4' x 40', 6' x 50', 5'6" x 50', 70" x 35'.
3—Louisville 8' x 50' Stainless Steel lined Rotary Dryers.
1—Traylor 30" x 18' Stainless Steel Rotary Dryer.
2—Link Belt; 7'5" x 25", 6'4" x 24' S.S. Louvre Dryers.

## MIXERS

1—Baker Perkins #16TRM, 150 gal. jktd., Vac. 60 HP.
1—Baker Perkins 100 gal. jktd., Sigma Blades.
5—Day "Cincinnatus" double arm, 250 and 100 gal.
1—1500# Powder Mixers, 7½ HP XP motor.
2—Steel, jktd. Powder Mixers: 225 and 350 cu. ft.

## MISCELLANEOUS

1—HPM 88 ton horizontal Steeping Press.
1—Ross, 6" x 14" Three Roll Mills.
3—Swenson Walker Continuous Crystallizers, 24" x 30' sections.
4—Rotex Sifters: 40" x 84", 60" x 84".
3—Robinson Gyratory Sifters, 30" x 104", Triple Deck.
8—Stokes DD2, DDS2, T, "R" and "F" Tablet Presses.
10—Nash Vac. Pumps: H6, L5, L3, TS7, #2, MD572.
25—Chloriment, Duriment and Duiron Centrifugal Pumps 1½" to 6".

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# STOCK ITEMS

### STAINLESS STEEL REACTORS—KETTLES

3—3,500 gal. Struthers Wells T316 SS kettles, jacketed, internal coils, 40/20 HP agitators.
1—2,200 gal. reactor, T316 SS, vacuum internal, 45# jkt., vertical agit.
2—1,850 gal. reactors, T316 SS, jacketed, vert. agit.
1—1,400 gal. jacketed kettle, T304 SS, 5 HP XP agit.
1—1,400 gal. reactor, T316 SS, ASME 175# IWP, jacketed, 20 HP XP agit.
3—1,100 gal. T316 SS, kettles, internal coils, agit.
3—750 gal. T304 SS kettles or fermenters, ASME 30# IWP, 30# jacket, 10 HP XP agit.
1—750 gal. T304 SS reactor, jacketed, agit.
2—500 gal. T316 SS reactors, vacuum, jacket, 10 HP agit.
1—350 gal. reactor, T304 SS, vacuum, jacketed, agit.
5—465 gal. reactors, T304 LSS, 175# IWP, 165# jacket.
1—600 gal. B&S T304 SS evaporating kettle.

### MILLS

2—Raymond #5057 hi-side
1—Kennedy 4' x 8' rod mill, 50 HP
4—A-C 5' x 22' ball mills, 150 HP
1—Traylor 8' x 11' ball mill, 300 HP
1—Penna. non-clog swing hammermill, 400 HP, UNUSED, 48" x 60".
1—Hardinge 4'6" x 16" conical ball mill.
3—Jaw Crushers: 36" x 15", 20" x 6".

### ROTARY KILNS—DRYERS

1—11' x 155' Traylor, ⅞" shell Kiln.
1—9' x 100' Vulcan, ⅝" shell Kiln.
1—8' x 125' Kiln, ⅝" shell.
1—8' x 115' ⅝" shell, 2-tire Kiln.
2—7'6" x 100' ½" shell Kilns.
1—7'6" x 60' Kiln, ½" shell.
4—Hardinge 8'8" x 7' Dbl. shell dryers, #XA-18, welded, ½" shell.
1—7'6" x 65' dryer, ½" welded shell.
1—Allis-Chalmers 7' x 50' dryer.
1—8' x 50' Louisville dryer.
6—Steel dryers: 5'6" x 50', 4'9" x 32', 4'6" x 40', 4'6" x 32', 4' x 30', 3' x 15'.
2—Stainless dryers: 4'6" x 12', 3' x 10'.

### TANKS

1—8000 gal. T304 SS, vert.
12—4500 gal. nickel-clad, vert. 125#.
1—3000 gal. alum., vert., open.
1—10,500 gal., T 304 SS, horiz., UNUSED, dished heads.
2—5700 gal., T304 SS, horiz., UNUSED.
4—Vacuum tanks w/coils, T304 SS: 3700, 3000, 2350, 1750 gal.
1—3400 gal., T304 SS, horiz.
1—2000 gal., T316 SS, hopper.
8—1750 gal., T304 SS, hoppers.
1—1400 gal., T316 SS, ASME, 175#.

24—SHARPLES #16 Super Centrifugals. Inconel bowls, stainless steel covers, 3hp TEFC motor.

# 3 MILLION DOLLAR LIQUIDATION

## Type 316 Stainless Steel Equipment

## CHEMICAL PLANT—ORANGE, TEXAS

### TYPE 316 STAINLESS STEEL TANKS

1—17,650 gal. 9' dia. x 36' long, T316 SS, ¼" shell, ⅜" heads w/coil.
2—6,500 gal. 11' dia. x 7' high, T316 SS, 7/16" shell, ½" heads.
12—2,300 gal. 7' dia. x 8' high, T316 SS, ¼" shell, coils (some with agitator).
2—2,000 gal. 6'6" O.D. x 8' long, ¼" shell.
2—1,100 gal. 5'6" dia. x 6' high, T316 SS, w/coils, with agitator.
4—1,200 gal. 5' dia. x 7' high, dished top, 42" deep conical bottom (crystallizer tanks).
7—560 gal. 3'6" dia. x 7' high, ¼" dished top, 4' deep conical bottom.

### STAINLESS STEEL COLUMNS

1—108" Dia. Vulcan scrubber, 10 trays on 12" centers, 252—bubble caps per tray.
1—96" dia. x 13' high scrubber, 10 stainless steel trays on 12" centers, 276—caps.
2—96" dia. x 35' high bubble cap columns, 30 trays, 12" spacing, 272—caps per tray.
2—60" dia. x 13' high, Vulcan scrubbers, ¼" shell, 10 trays, 100—caps per tray.
1—48" dia. column, 25 trays, bubble caps, T304-ELC.
3—30" dia. packed columns, 25' high, T316 SS.
4—24" dia. bubble cap columns, 12 trays, T316 SS, 18" spacing—Vacuum.

### COPPER COLUMNS

1—72" dia. Vulcan bubble cap copper column, 46'10" high, 40—trays.—Vacuum.
2—48" dia. bubble cap copper columns, 25 & 40 trays, 31' & 45' high.—Vacuum.
2—42" dia. Vulcan stills, 56" high. (Evaporator bodys).
1—24" dia. column, 25'8½" long, 20 trays, bubble caps.

### FILTERS—CRYSTALLIZERS

2—Sharples C-20 Super-D-Hydrators T316 SS.
3—18,000 gal. Aluminum Cone bottom tanks, 12' dia. x 31' O.A.H.
4—1200 gallon Crystallizers, T316 SS, 5' dia. x 7' high, dished top, conical bottom.
7—560 gal. Crystallizers, T316 SS, 3'6" dia. x 7" high, dished top, conical bottom.
3—Worthington 160 Ton steam jet refrigeration units.

### TYPE 316 STAINLESS STEEL KETTLES

3—3,500 gal. jacketed kettles, 7' dia. x 12' high, T316 SS. 11/32" shell, dished heads, 11 turns SS coil, two-speed agitator, 40/20 HP-1750/500 RPM.
1—2,500 gal. 6' dia. x 12' high, T316 SS, horiz. still kettle.
1—2200 gal. jacketed reactor, T316 SS, vacuum int., agit.
2—1850 gal. jacketed reactors, T316 SS, vert. agit.

### CONDENSERS—HEAT EXCHANGERS—CALANDRIAS—COOLERS

1—1,450 sq. ft. condenser, stainless steel tubes, tube sheets, heads, and baffles.
1—1,200 sq. ft. condenser, stainless steel tube, steel shell.
14—750 & 800 sq. ft. stainless steel condensers, vertical, T316 SS tubes and heads.
9—Condensers, 358, 400, 410, and 550 sq. ft., T316 SS.
5—Calandrias, 140, 145, 150, 157, 250, 277 sq. ft., T316 SS.
11—Exchangers, 64, 70, 75, 80, 100 sq. ft., T316 SS.
12—Exchangers 20, 30, 47, 50 52, 54 sq. ft., T316 SS.
15—Cupro-Nickel & Copper exchangers, up to 1070 sq. ft.

### MISCELLANEOUS EQUIPMENT

10,000—T316 SS pipe & tubing, 1", 2", 3", etc. up to 12".
2,000—Valves, T316 SS, up to 12", Flanged—Gate or Globe.
1—Otis elec. freight elevator, 5000# @ 75 FPM.
1—P&H 5 ton travelling crane.
2—T304 SS weigh tanks or bins, 12' x 10' x 10', w/scales.
6—Ingersoll-Rand #5HC cent. pumps, 6" x 5", T316 SS.
40—Stainless steel pumps 1" to 6", 1 HP to 20 HP.
2—St. St. bucket elevators, 62' and 45' high.
4—Stainless steel screw conveyors and chutes.
1—2,000 gal. aluminum tank, 6' dia. x 10' high, coils.
18—Separators, T316 SS, 22" x 8' overall depth, cone type.
1—Croll-Reynolds #21 jet vacuum air pump, capacity 50# per hour.

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**1—Struthers Wells type 316 SS 3500 gal. jacketed reactor**
**8—Alco type 316 SS jacketed reactors, 3000 gal.**
**25—Davis Eng. SS heat exchangers, 145 sq.ft. and 230 sq.ft. NEW**

### AUTOCLAVES, KETTLES AND REACTORS

1—Steel & Alloy Tank Co. 225 gal. type 347 SS jacketed autoclave, 250# jacket and 250# internal pressure
1—Steel & Alloy Tank Co. 125 gal. type 347 SS jacketed autoclave, 250# jacket and 250# internal pressure
1—Steel & Alloy Tank Co. 350 gal. type 347 SS pressure tank, 250# jacket and 250# internal pressure
1—Steel & Alloy Tank Co. 100 gal. type 347 pressure tank, 250# pressure
1—Blaw-Knox 400 gal. steel jacketed autoclave, 570# internal pressure, 85# jacket
1—Blaw-Knox 45 gal. steel jacketed autoclave, 1500# pressure
2—Pfaudler 500 gal. glass lined reactors, complete with anchor type agitators and drives
1—Pfaudler type 316 SS jacketed reactor, 150 gal. 85# jacket and 75# internal
1—Edgemoor Iron Works type 316 SS jacketed reactor, 750 gal.
2—Struthers Wells 500 gal. nickel jacketed reactors
1—Patterson-Kelley 6000 gal. steel jacketed reactor, 40# jacket, complete with agitator & drive

### DRYERS

1—Link Belt steel roto louver dryer, Model 1003-30
4—Link Belt steel roto louver dryers, Model 207-10, 310-16, 310-20, 604-20
1—Buflovak double drum dryer, 42" x 120"
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
1—Stokes double drum dryer, 5' x 12'
1—Louisville rotary steam tube dryer, 8' x 45'
1—Louisville SS rotary kiln, 30" x 28', complete
1—Louisville rotary dryer, 38" x 40', Type L
3—Louisville SS rotary dryers, 8' x 50'
1—Ruggles Coles 4' x 30' rotary kiln
1—Traylor 4' x 40' rotary dryer
1—Swenson 10' dia. spray dryer
2—Rotary dryers, 6' x 36'

### FILTERS

3—Dorco rubber covered filters, 6' x 2'
1—Sweetland #3 SS filter
1—Niagara SS filter, Model 510-28
1—Oliver horizontal filter, 3'
1—Feinc SS rotary vacuum string filter, 3' x 3' (NEW)
10—Shriver plate and frame filter presses, 12" to 42"
1—Shriver rubber lined filter press, 36" x 36"
12—Sweetland #12 filters with 72 SS leaves

### CENTRIFUGES

1—AT&M 48" SS suspended type centrifuge, complete with plow and motor with imperforate basket
1—Tolhurst 40" suspended type centrifuge with perforated basket type 316 SS, complete with motor and plow
1—Tolhurst 40" suspended type centrifuge with perforated basket type 347 SS, complete with motor and plow
4—Tolhurst 30" center slung rubber covered centrifuge with perforated baskets and motors
1—AT&M SS suspended type centrifuge 18" imperforate basket, complete with motor and plow

*THE GELB GIRL—AUGUST 1959*

### MIXERS

2—Sturtevant #7 dustless type 304 SS batch blenders, (NEW)
1—Readco SS jacketed vacuum sigma blade double arm mixer, 25 gal.
3—Robinson type 316 SS sigma type jacketed heavy duty mixers, 400 gal.
5—Baker Perkins double arm sigma blade mixers, 100 gal.
1—Paterson monel double cone blender, 4 cu. ft.
19—Robinson SS horizontal blenders, 255 cu. ft.
1—12' x 4' type 316 SS pug mixer
1—Munson rotary blender, 40 cu. ft.
1—Baker Perkins 5 gal. double arm sigma blade jacketed mixer, size 8, Type CE, complete
1—Patterson type 347 SS jacketed vacuum, sigma kneader master, 500 gal.

### MISCELLANEOUS

1—Cleaver Brooks 500 HP package steam generator, 200#
2—Heat Transfer Products steel bubble cap columns, 36" and 42" with 5 and 10 trays
1—Acme steel bubble cap column, 42" dia. with 10 trays
2—Patterson-Kelley steel heat exchangers, 1000 sq. ft. each
6—Struthers Wells heat exchangers, 885 sq. ft.
1—Patterson-Kelley steel heat exchanger, 427 sq. ft.
50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft.
1—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
2—Badger type 316 SS heat exchangers, 500 sq. ft. and 630 sq. ft.
1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
1—Badger type 316 bubble cap column, 36" dia. with 8 trays
1—Vulcan SS bubble cap column, 4' x 28 plates
3—Robins shaker screens, SS, 3' x 6'
1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
1—Swenson type 316 SS vacuum crystallizer, 2' x 12'
1—Blaw Knox steel distillation column, 36" x 40' with 24 trays, complete (NEW)
3—Willams type 316 SS hammermills, Model AK

**1—Niagara SS filter Model 36-H-110-3**
**1—Ames 300 HP steam generator, 250#**
**3—Louisville SS rotary dryers, 8'x50'**
**1—Oliver type 316 SS rotary vacuum precoat filter, 3'x4'**

*Established 1856*

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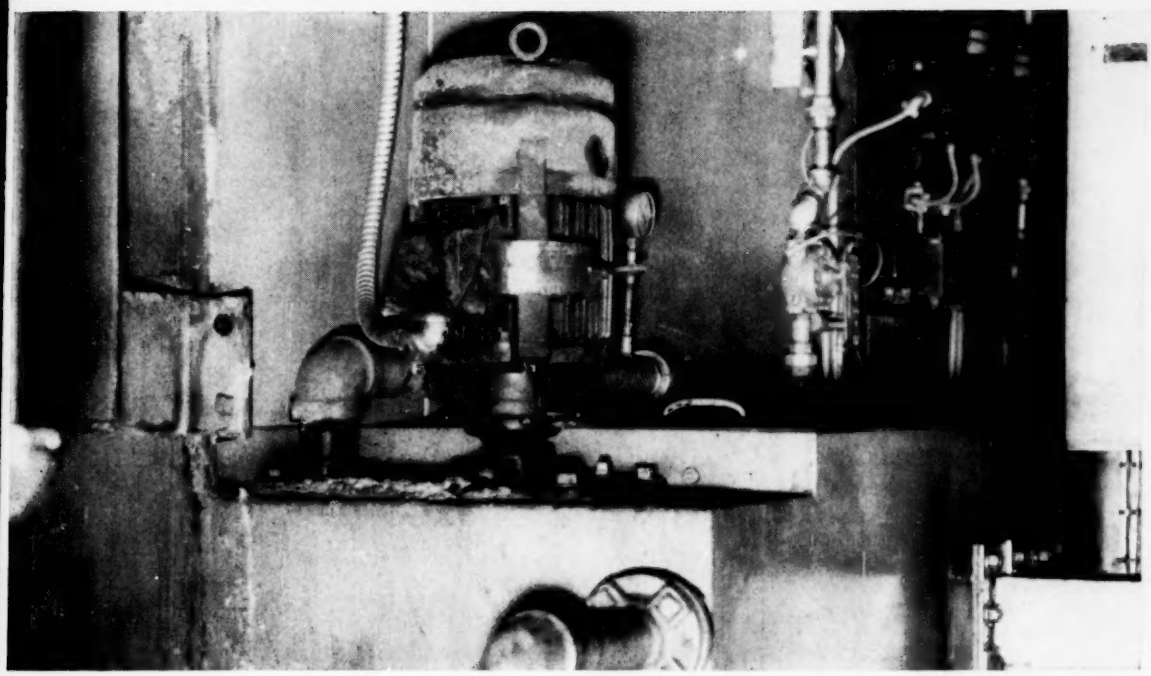

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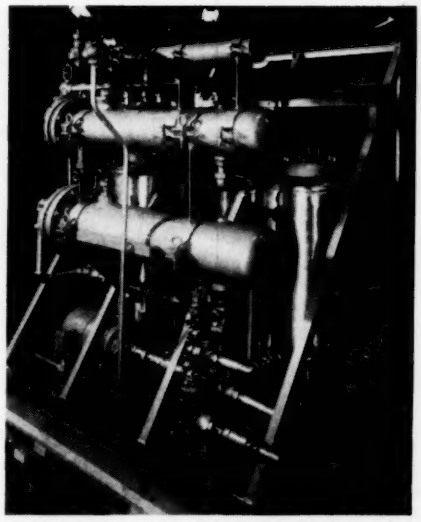

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